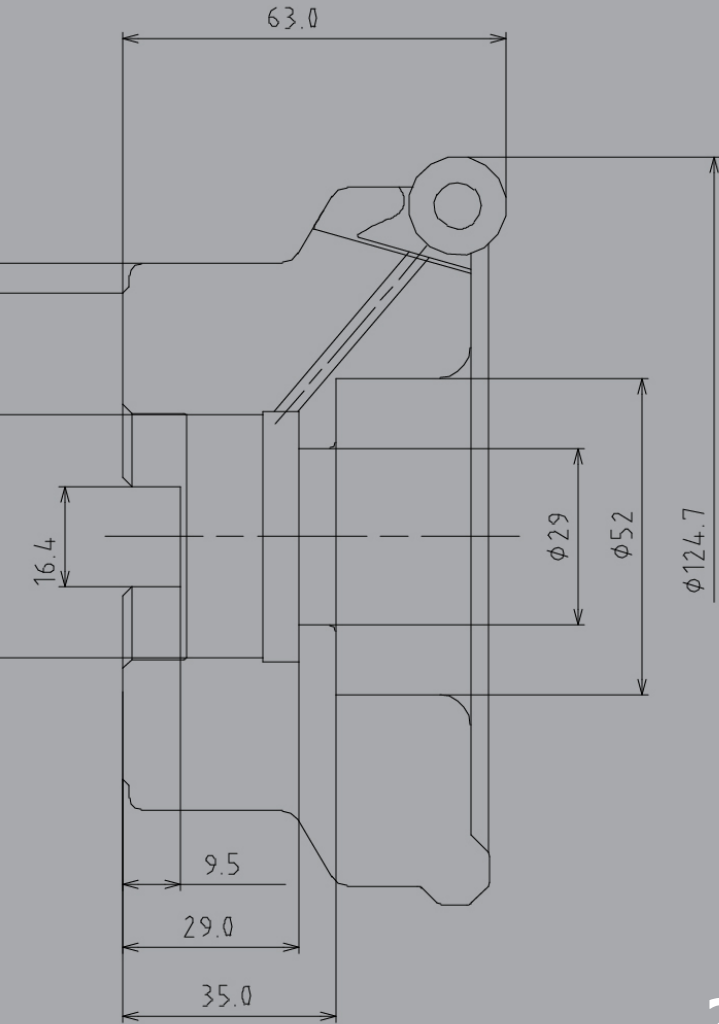
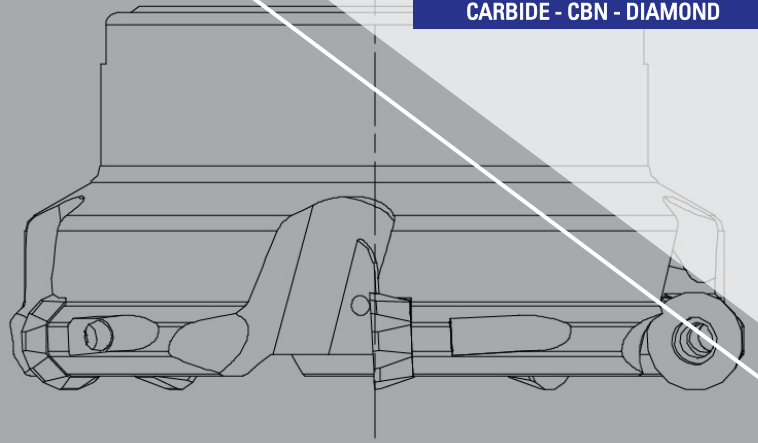


N-P



SUMITOMO

CARBIDE - CBN - DIAMOND

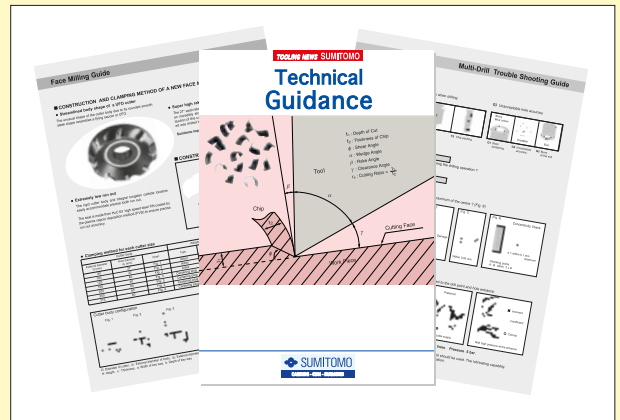


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Technical Guidance

Basics of Turning

Calculating Power Requirement

$P_c = \frac{d_{oc} \cdot f \cdot v_c \cdot K_c}{60 \times 10^3 \times \eta}$ $H = \frac{P_c}{0,75}$	<p>P_c : Net power requirement (KW) v_c : Cutting speed (m/min) f : Feed rate (mm/rev) a_p : Depth of cut (mm) η : Machine efficiency (0,70 ~ 0,85) K_c : Specific cutting force (N/mm²) H : Required horsepower (HP)</p>
------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

● Rough value of specific cutting force (K_c)

General steel :	2.500 ~ 3.000 N/mm ²
Cast iron :	1.500 N/mm ²
Aluminum :	800 N/mm ²

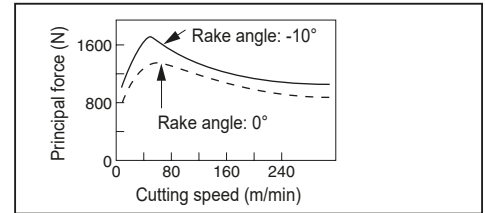
Cutting Force

F_1 : Principal force
 F_2 : Feed force
 F_3 : Back force

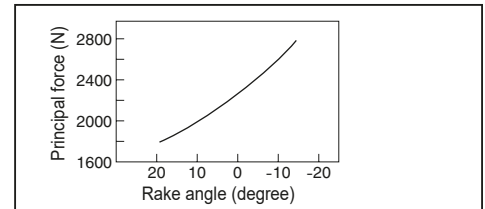
● Calculating cutting force

$P = K_c \cdot q$ $= \frac{K_c \times d_{oc} \times f}{1000}$	<p>P : Cutting force (N) K_c : Specific cutting force (N/mm²) q : Chip area (mm²) d_{oc} : Depth of cut (mm) f : Feed rate (mm/rev)</p>
---------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Cutting Speed and Cutting Force



Rake Angle and Cutting Force



Calculating Cutting Speed

① Calculating rotational speed from cutting speed

$n = \frac{1000 \cdot v_c}{\pi \cdot D}$	<p>n : Spindle speed (min⁻¹) v_c : Cutting speed (m/min) D : Diameter of workpiece (mm) $\pi \approx 3,14$</p>
------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

(Eg.) $v_c = 150$ m/min, $D = 100$ mm

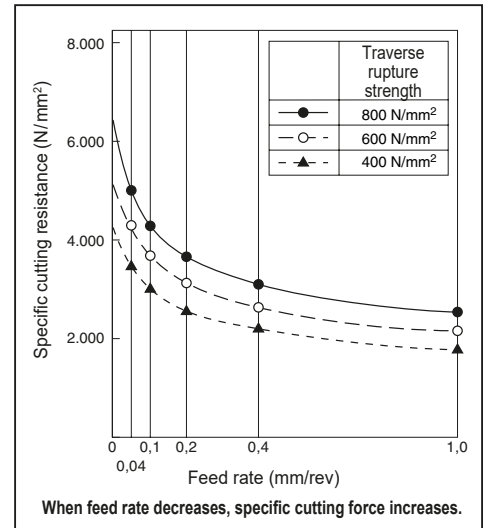
$$n = \frac{1000 \times 150}{3,14 \times 100} = 478 \text{ (min}^{-1}\text{)}$$

② Calculating cutting speed from rotational speed

$v_c = \frac{\pi \cdot D \cdot n}{1.000}$	Refer to the above table
-------------------------------------------	--------------------------

n : Spindle speed (min⁻¹)
 v_c : Cutting speed (m/min)
 f : Feed rate (mm/rev)
 d_{oc} : Depth of cut (mm)
 D_m : Diameter of workpiece (mm)

Feed Rate and Specific Cutting Force (For carbon steel)



Roughness

● Theoretical Surface Finish

$R_z = \frac{f^2}{8 \times r}$	<p>R_z : Surface finish (mm) f : Feed rate (mm/rev) r : Nose radius (mm)</p>
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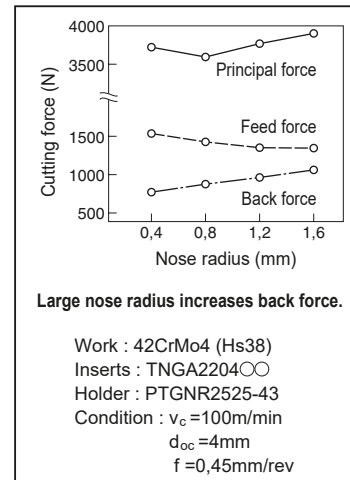
● Actual surface roughness

Steel : Theoretical surface finish x 1,5 ~ 3
 Cast iron : Theoretical surface finish x 3 ~ 5

● Ways to Improve Surface Finish

- Use an insert with a larger nose radius.
- Optimize the cutting speed and feed rate so that built-up edge does not occur.
- Select an appropriate insert grade.
- Use wiper insert.

Nose Radius and Cutting Force



Forms of Tool Failures

	Cat.	No.	Name of Failure	Cause of Failure
	Resulting from Mechanical causes	1~5	Flank Wear	Due to the scratching effect of hard grains contained in the work material.
		6	Chipping	Fine breakages caused by high cutting loads or chattering.
		7	Fracture	Due to the impact of an excessive mechanical force acting on the cutting edge.
	Resulting from Chemical reactions	8	Crater Wear	Swafft chips removing tool material as it flow over the top face at high temperatures.
		9	Plastic Deformation	Cutting edge is depressed due to softening at high temperatures.
		10	Thermal Crack	Fatigue from rapid, repeated heating and cooling cycles during machining.
		11	Built-up Edge	Work material is pressure welded on the top face of the cutting edge.

Tool Wear

Forms of Tool Wear

Bad chip control
Cutting edge fracture

Creater wear K_T

Burs occur

Side flank wear V_{N1}

Flank wear V_B

Higher cutting force

Poor surface finish

Face flank wear V_{N2}

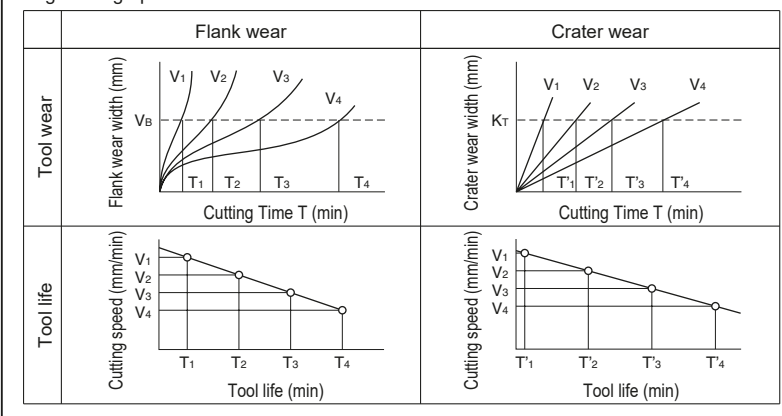
Edge wear V_c

Poor machining accuracy
Burs occur

	Flank wear	Crater wear
Graph		
Description	Wear is rapid initially, then it proceeds more gradually in proportion with cutting time until a certain limit, beyond which it increases rapidly again.	Crater wear is more progressive with no sudden breakdown pattern.

Tool Life (V-T)

Measure the relative tool lives of the specified wear, over a range of cutting speeds, then plot the tool life along the X-axis and the cutting speed along the Y-axis on a double logarithm graph.



Technical Guidance

Tool Failure and Remedies

■ Trouble Shooting Guide for Turning

	Damage	Cause	Countermeasures
Tool Edge Failure	<p>Excessive flank wear</p> 	<ul style="list-style-type: none"> - Grade lacks wear resistance. - Cutting speed is too fast. - Feed rate is far too slow. 	<ul style="list-style-type: none"> - Select a wear resistant grade. P30 ⇨ P20 ⇨ P10 K20 ⇨ K10 ⇨ K01 - Use an insert with a larger rake angle. - Decrease the cutting speed. - Increase feed rates.
	<p>Excessive crater wear</p> 	<ul style="list-style-type: none"> - Grade lacks crater wear resistance. - Rake angle is too small. - Cutting speed is too fast. - Feed rate and depth of cut are too large. 	<ul style="list-style-type: none"> - Select a more crater-resistant grade. - Use an insert with a larger rake angle. - Select an appropriate chipbreaker. - Decrease the cutting speed. - Decrease the D.O.C. and feed rate.
	<p>Cutting edge chipping</p> 	<ul style="list-style-type: none"> - Grade lacks toughness. - Insert falls off due to chip build-up. - Cutting edge lacks toughness. - Feed rate and depth of cut are too large. 	<ul style="list-style-type: none"> - Change to tougher grades. P10 ⇨ P20 ⇨ P30 K01 ⇨ K10 ⇨ K20 - Increase amount of honing on cutting edge. - Reduce rake angle. - Reduce feed rates and depth of cut.
	<p>Cutting edge fracture</p> 	<ul style="list-style-type: none"> - Grade lacks toughness. - Cutting edge lacks toughness. - Holder lacks toughness. - Feed rate is too fast. - Depth of cut is too large. 	<ul style="list-style-type: none"> - Change to tougher grades. P10 ⇨ P20 ⇨ P30 K01 ⇨ K10 ⇨ K20 - Select a chipbreaker with a strong cutting edge. - Select a holder with a larger approach angle. - Select a holder with a larger shank size. - Decrease the D.O.C. and feed rate.
	<p>Build-up edge</p> 	<ul style="list-style-type: none"> - Inappropriate grade selection. - Dull cutting edge. - Cutting speed is too slow. - Feed rate is too slow. 	<ul style="list-style-type: none"> - Select a grade with less affinity to the work material. Coated carbide or cermet grades. - Select a grade with a smooth coating. - Use an insert with a larger rake angle. - Reduce amount of honing. - Increase cutting speeds. - Increase feed rates.
	<p>Plastic deformation</p> 	<ul style="list-style-type: none"> - Grade lacks thermal resistance. - Cutting speed is too fast. - Feed rate is too fast. - Depth of cut is too large. - Not enough cutting fluid. 	<ul style="list-style-type: none"> - Select a more crater-wear-resistant grade. - Use an insert with a larger rake angle. - Decrease the cutting speed. - Reduce feed rates and depth of cut. - Supply a sufficient amount of coolant.
	<p>Notch wear</p> 	<ul style="list-style-type: none"> - Grade lacks wear resistance. - Rake angle is too small. - Cutting speed is too fast. 	<ul style="list-style-type: none"> - Select a wear resistant grade. P30 ⇨ P20 ⇨ P10 K20 ⇨ K10 ⇨ K01 - Use an insert with a larger rake angle. - Alter depth of cut to shift the notch location.

■ Type of Chip Generation

	a	b	c	d
Shape				
Condition	Continuous chips with good surface finish.	Chip is sheared and separated by the shear angle.	Chips appear to be torn from the surface.	Chips crack before reaching the cutting point.
Application	Steel, Stainless steel	Steel, Stainless steel (Low speed)	Steel, Cast iron (Very low speed, very small feedrate)	Cast iron, Carbon
Influence factor	Easy ← Work deformation → Difficult Large ← Rake angle → Small Small ← D.O.C. → Large Fast ← Cutting speed → Slow			

■ Type of Chip Control

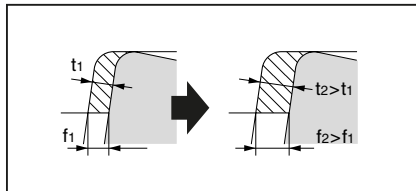
Feed rate	A	B	C	D	E
Large feed rate					
Small feed rate					
NC lathe (For automation)	×	×	○	○	△
General lathe (For safety)	×	○	○	○ ~ △	×

Good : C type, D type

Poor {
 A type : Twines around the tool or workpiece, damages the machined surface and affects safety.
 B type : Bulky, causes problems in the automatic chip conveyor and chipping occurs easily.
 E type : Causes spraying of chips, poor machined surface due to chattering, chipping, large cutting force and high temperatures.

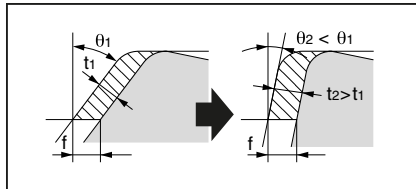
■ Factor of Improvement Chip Control

① Increase feed rate



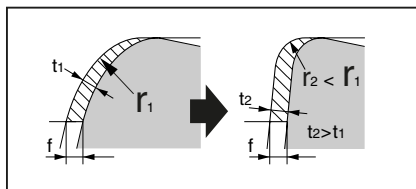
When feedrate increase, chips become thick and chip control improves.

② Decrease side cutting edge



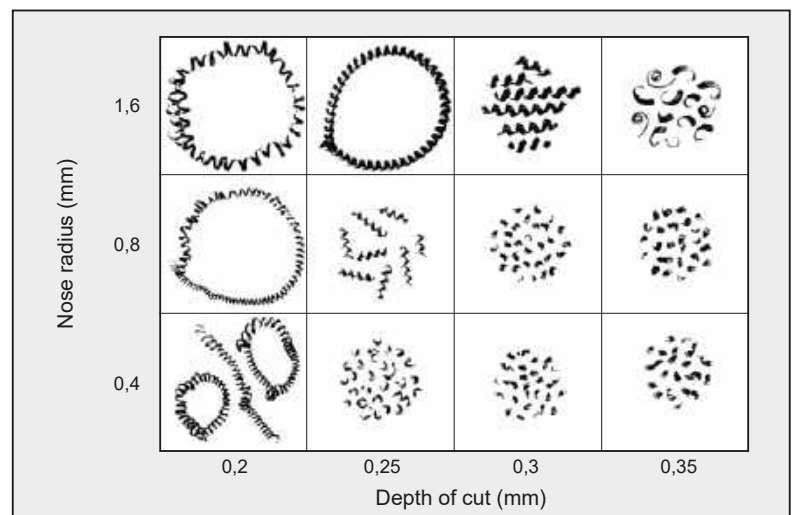
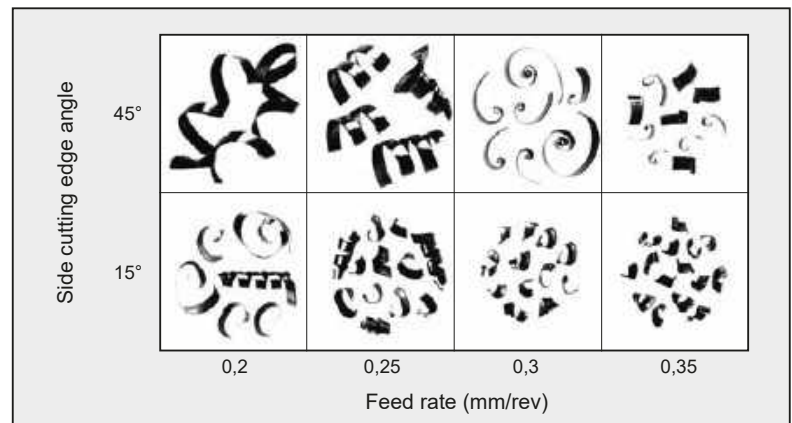
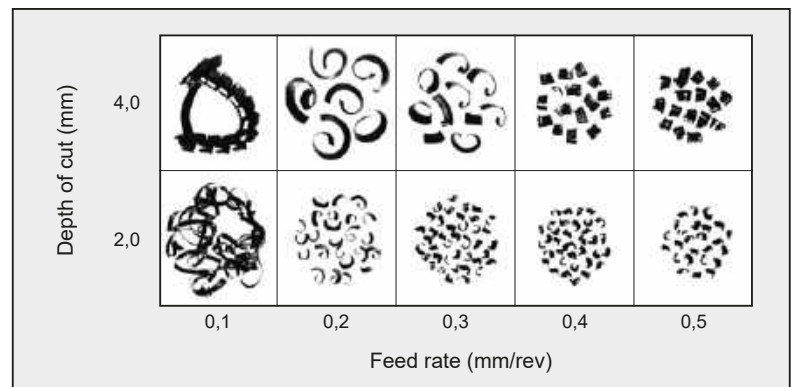
Even if feed rate is the same, smaller side cutting edge angle makes chips thick and chip control improves.

③ Decrease nose radius



Even if depth of cut is the same, smaller nose radius makes chip thick and chip control improves.

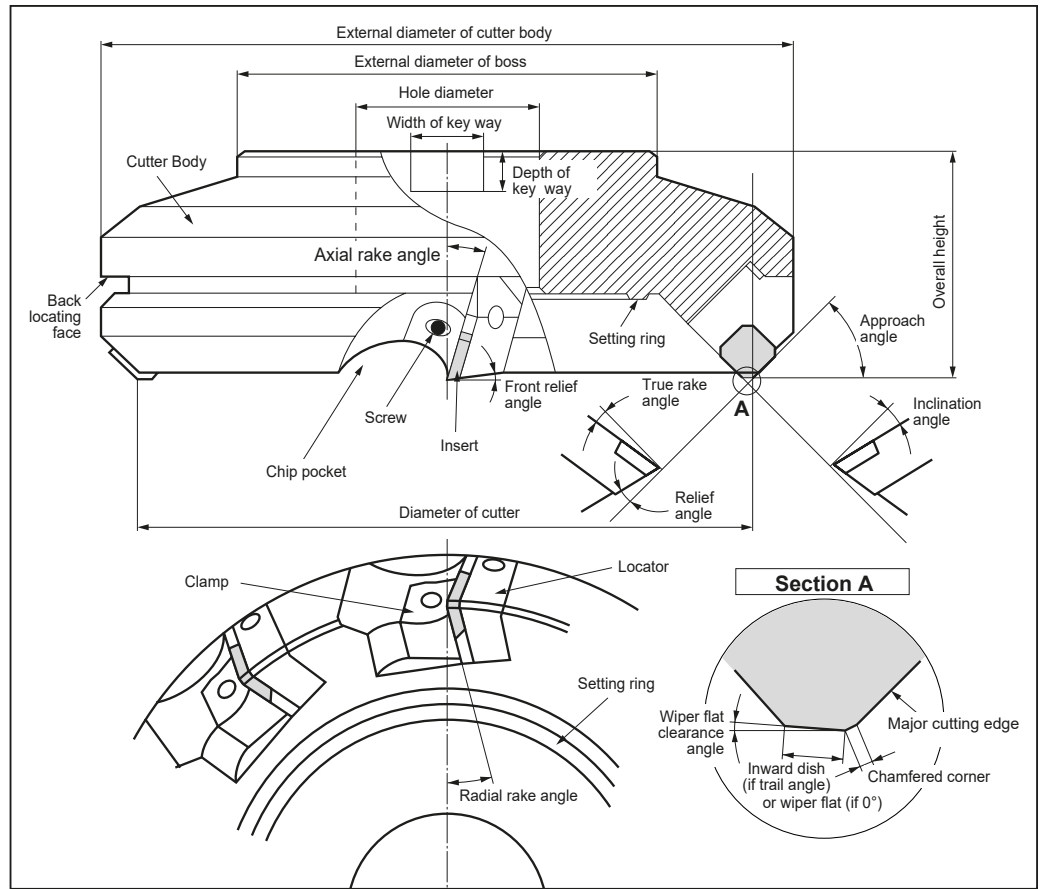
* Cutting resistance increases in proportion with the width of the contact surface. Therefore, with a larger nose radius, cutting resistance and back force increases, chattering may also occur. However, with the same feedrate, a smaller nose radius would produce a poorer surface finish.



Technical Guidance

Basics of Milling

Parts of a Milling Cutter



Power Requirement

Calculating cutting force

$$P_c = \frac{d_{oc} \cdot w_{oc} \cdot v_f \cdot K_c}{60 \times 10^6 \times \eta} \text{ (kW)}$$

Horsepower

$$H = \frac{P_c}{0,75}$$

Chip removal amount

$$Q = \frac{d_{oc} \times w_{oc} \times v_f}{1.000} \text{ (cm}^3\text{/min)}$$

P_c : Net power requirement (kW)

H : Horsepower requirement (HP)

Q : Chip removal amount (cm³/min)

w_{oc} : Cutting width (mm)

v_f : Feed speed (mm/min)

d_{oc} : Depth of cut (mm)

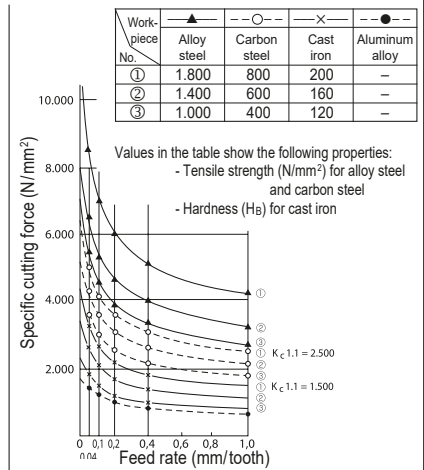
η : Machine efficiency (0,70 ~ 0,85)

K_c : Specific cutting force (N/mm²)

Eg. rough value

Steel : 2.500 ~ 3.000
Cast iron : 1.500

Relation between feed rate, work material, specific cutting force



Calculating cutting speed

$$v_c = \frac{\pi \times D \times n}{1.000}$$

v_c : Cutting speed (m/min)

$\pi \approx 3,14$

D : Cutter diameter (mm)

n : Rotation speed (rpm)

v_f : Feed speed (mm/min)

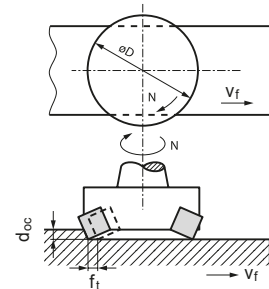
f_t : Feed rate (mm/tooth)

Z : Number of teeth

Calculating feed rate

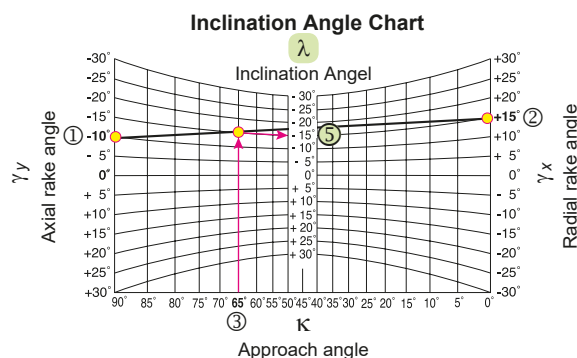
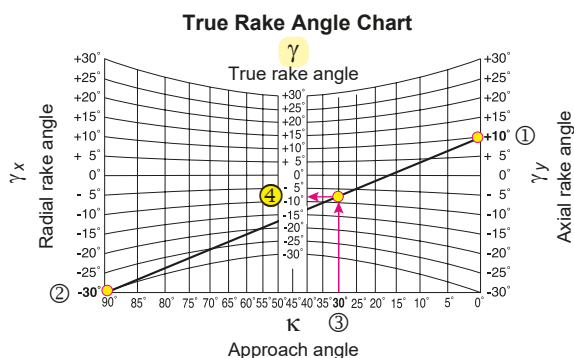
$$v_f = f_t \times z \times n$$

$$f_t = \frac{v_f}{z \times n}$$



Functions of the Various Cutting Angles

	Description	Code	Functions	Influences
①	Axial rake angle	γ_y	Controls chip removal direction, effects adhesion of the chips and thrust force etc.	Rake angles can vary from positive to negative (large to small) with typical combinations of positive and negative, positive and positive or negative and negative configurations.
②	Radial rake angle	γ_x		
③	Approach angle	κ	Controls chip thickness and chip removal direction	The effect of the small approach angle is to reduce the chip thickness and cutting force.
④	True rake angle (Effective rake angle)	γ	Controls cutting performance and ability to retain a cutting edge	<ul style="list-style-type: none"> - With a positive (large) angle, cutting ability and adhesion resistance are improved but the strength of the cutting edge is weakened. - With negative (small) angle, the strength of the cutting edge is improved but chips will tend to adhere more easily.
⑤	Inclination angle	λ	Controls chip removal direction	- With a positive (large) angle, the chip removal is satisfactory with less cutting resistance but the strength of the corner is weaker.
⑥	Wiper flat clearance angle	α_f	Controls surface finish	A smaller clearance angle will produce a better surface finish.
⑦	Clearance angle	α	Controls edge strength, tool life and chattering, etc	



Example in using the above chart:	Solution:
① γ_y : Axial rake angle = +10°	True rake angle
② γ_x : Radial rake angle = -30°	④ $\gamma = -8^\circ$
③ κ : Approach angle = 30°	

Formula : $\tan \gamma = \tan \gamma_x \cdot \sin \kappa + \tan \gamma_y \cdot \cos \kappa$

Example in using the above chart :	Solution:
① γ_y : Axial rake angle = -10°	Inclination angle
② γ_x : Radial rake angle = +10°	⑤ $\lambda = -15^\circ$
③ κ : Approach angle = 65°	

Formula : $\tan \lambda = \tan \gamma_y \cdot \sin \kappa - \tan \gamma_x \cdot \cos \kappa$

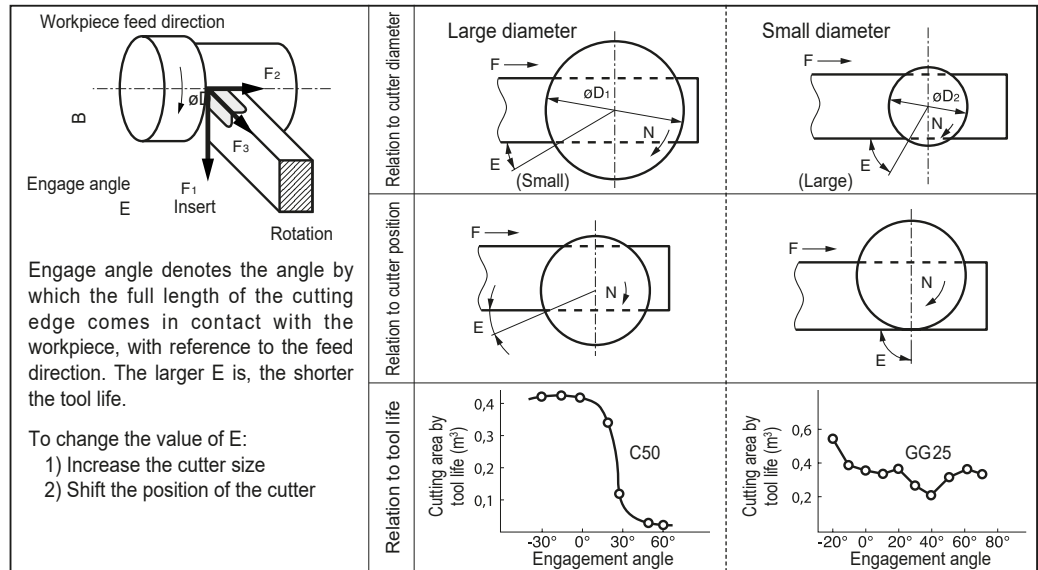
Rake Angle Combination

	Negative - Positive Type	Double Positive Type	Double Negative Type
The effects of the various angle configurations with relation to chip formation and chip removal.			
Advantage	Excellent chip removal and good cutting action	Good cutting action	Double-sided inserts can be use and higher cutting edge strength
Disadvantage	Only single-sided inserts can be use	Lower cutting edge strength and only single-sided inserts can be use	Dull cutting action
Application	For Steel, Cast iron, Stainless steel, Alloy steel	For general milling of steel For low rigidly work piece	For light milling of cast iron and steel
Typical cutter	WGX, WGC, UFO	DPG	DNX, DGC, DNF
Chips (Eg.) Workpiece: 37Cr4 $v_c = 130$ m/min $f_t = 0.23$ mm/tooth $d_{oc} = 3$ mm			

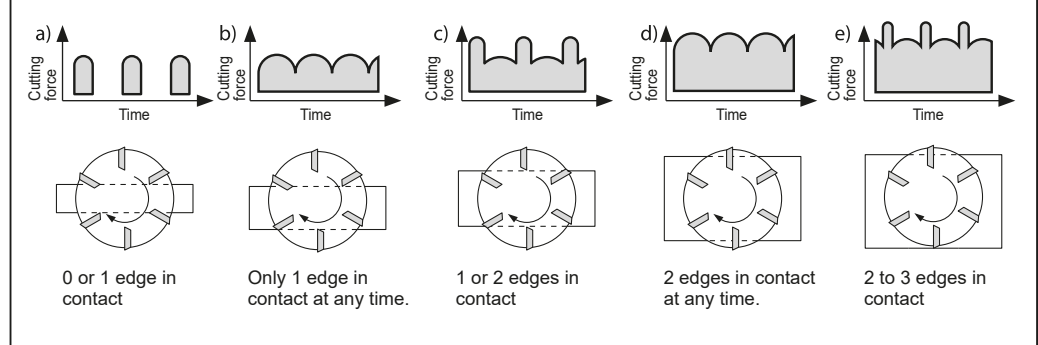
Technical Guidance

Basics of Milling

Relation Between Engage Angle and Tool Life



Relation between the number of simultaneously engaged cutting edges and cutting force:



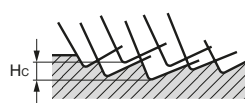
To Improve Surface Roughness

① Milling inserts with wiper flat

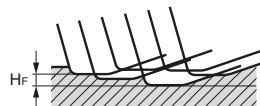
When all the cutting edges have wiper flats, a few teeth are intentionally elevated to play the role of a wiper insert.

- Insert equipped with straight wiper flat (Face angle: Approx 15' - 1°)
- Insert equipped with curved wiper flat (Eg. curvature R500)

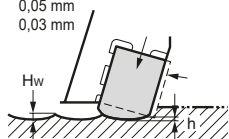
● Surface roughness without wiper flat



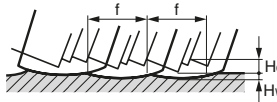
● Surface roughness with straight wiper flat



h : Projected value of wiper insert
 Steels: 0,05 mm
 Al: 0,03 mm

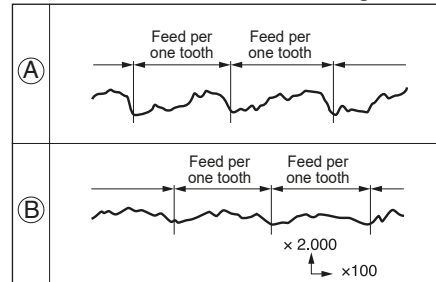


f : Feed rate per revolution



H_c : Surface roughness with only normal teeth
 H_w : Surface roughness with wiper insert

● Influence of different face angles on surface finish



- Workpiece: 34CrMo4
 - Cutter: DPG 5160 R (Single tooth)

- $v_c = 154$ m/min
 $f_t = 0,234$ mm/tooth
 $d_{oc} = 2$ mm

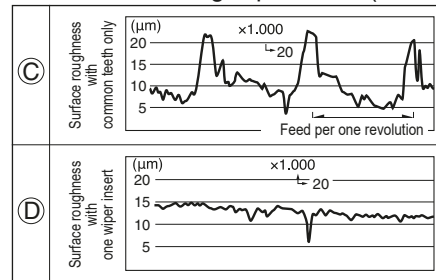
- Face angle
 (A): 28'
 (B): 6'

② Integral wiper insert system

A system to protrude one or two inserts (wiper insert) with a smooth curved edge just a little beyond the other teeth to wipe the milled surface.

- (Applies to WGC, RF types etc.)

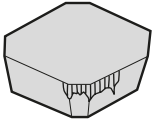
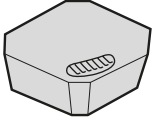
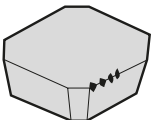
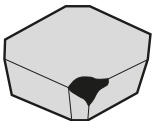
● Effects of having wiper insert (example)



- Workpiece: GG25
 - Cutter: DPG 4100 R
 - Insert: SPKN 1203
 - Axial run-out: 0,015 mm
 - Radial run-out: 0,04 mm

- $v_c = 105$ m/min
 $f_t = 0,29$ mm/tooth (1,45 mm/rev)
 (C): Only normal teeth
 (D): with 1 wiper insert

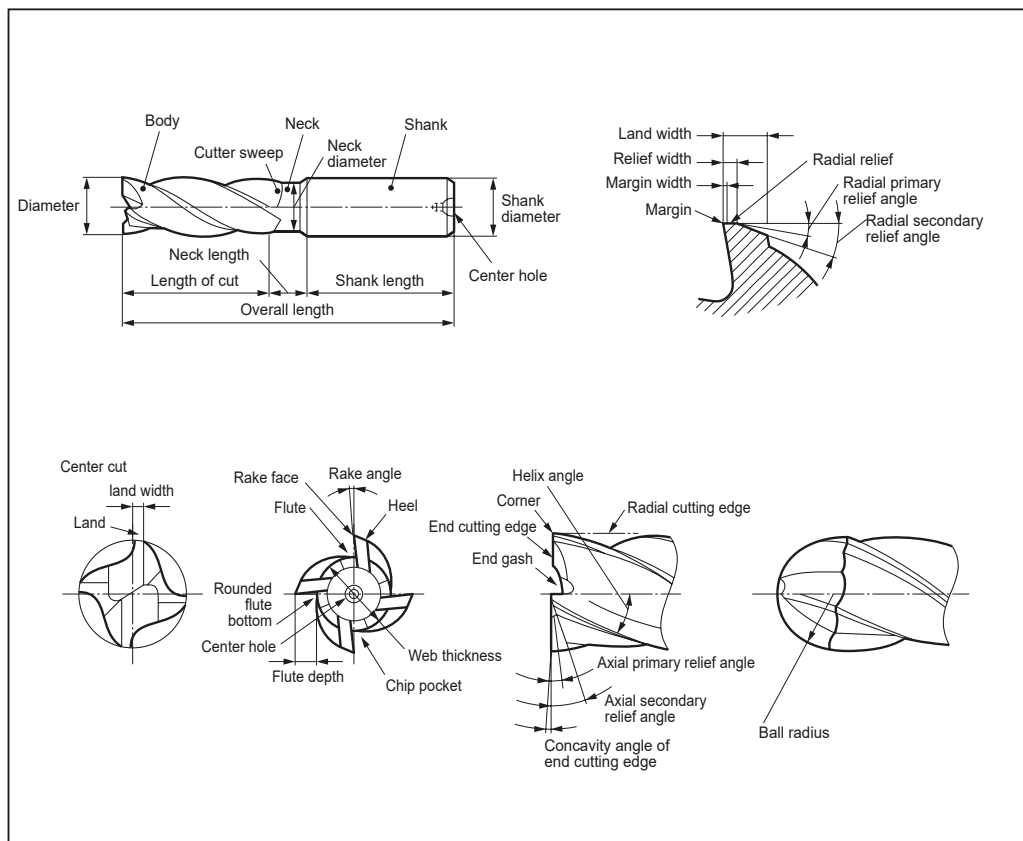
■ Trouble Shooting Guide for Milling

Trouble		Basic Remedies		Remedy Examples															
Cutting Edge Failure	Excessive Flank Wear 	Tool Material	<ul style="list-style-type: none"> Select a more wear resistant grade. Carbide P30 ⇒ P20 ⇒ P30 K20 ⇒ K10 ⇒ K10 Coated Cermet 	- Recommended insert grades <table border="1"> <thead> <tr> <th></th> <th>Steel</th> <th>Cast Iron</th> <th>Non-Ferrous Alloy</th> </tr> </thead> <tbody> <tr> <td>Finishing</td> <td>T250A (Cermet)</td> <td>ACK200 (Coated Carbide) BN700 (SUMIBORON)</td> <td>DA1000 (SUMIDIA)</td> </tr> <tr> <td>Roughing</td> <td>ACP100 (Coated Carbide)</td> <td>ACK200 (Coated Carbide)</td> <td>DL1000 (Coated Carbide)</td> </tr> </tbody> </table>					Steel	Cast Iron	Non-Ferrous Alloy	Finishing	T250A (Cermet)	ACK200 (Coated Carbide) BN700 (SUMIBORON)	DA1000 (SUMIDIA)	Roughing	ACP100 (Coated Carbide)	ACK200 (Coated Carbide)	DL1000 (Coated Carbide)
		Steel	Cast Iron	Non-Ferrous Alloy															
	Finishing	T250A (Cermet)	ACK200 (Coated Carbide) BN700 (SUMIBORON)	DA1000 (SUMIDIA)															
	Roughing	ACP100 (Coated Carbide)	ACK200 (Coated Carbide)	DL1000 (Coated Carbide)															
Excessive Crater Wear 	Tool Material	<ul style="list-style-type: none"> Select a crater resistant grade. 	- Recommended insert grades <table border="1"> <thead> <tr> <th></th> <th>Steel</th> <th>Cast Iron</th> <th>Non-Ferrous Alloy</th> </tr> </thead> <tbody> <tr> <td>Finishing</td> <td>T250A (Cermet)</td> <td>ACK200 (Coated Carbide)</td> <td>DA1000 (SUMIDIA)</td> </tr> <tr> <td>Roughing</td> <td>ACP100 (Coated Carbide)</td> <td>ACK200 (Coated Carbide)</td> <td>DL1000 (Coated Carbide)</td> </tr> </tbody> </table>					Steel	Cast Iron	Non-Ferrous Alloy	Finishing	T250A (Cermet)	ACK200 (Coated Carbide)	DA1000 (SUMIDIA)	Roughing	ACP100 (Coated Carbide)	ACK200 (Coated Carbide)	DL1000 (Coated Carbide)	
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Finishing	T250A (Cermet)	ACK200 (Coated Carbide)	DA1000 (SUMIDIA)																
Roughing	ACP100 (Coated Carbide)	ACK200 (Coated Carbide)	DL1000 (Coated Carbide)																
Cutting Edge Chipping 	Tool Material	<ul style="list-style-type: none"> Select tougher grade. P10 ⇒ P20 ⇒ P30 K01 ⇒ K10 ⇒ K20 	- Recommended insert grades <table border="1"> <thead> <tr> <th></th> <th>Steel</th> <th>Cast Iron</th> </tr> </thead> <tbody> <tr> <td>Finishing</td> <td>ACP200 (Coated Carbide)</td> <td>ACK200 (Coated Carbide)</td> </tr> <tr> <td>Roughing</td> <td>ACP300 (Coated Carbide)</td> <td>ACK300 (Coated Carbide)</td> </tr> </tbody> </table>					Steel	Cast Iron	Finishing	ACP200 (Coated Carbide)	ACK200 (Coated Carbide)	Roughing	ACP300 (Coated Carbide)	ACK300 (Coated Carbide)				
	Steel	Cast Iron																	
Finishing	ACP200 (Coated Carbide)	ACK200 (Coated Carbide)																	
Roughing	ACP300 (Coated Carbide)	ACK300 (Coated Carbide)																	
Partial Fracture of Cutting Edges 	Tool Material	<ul style="list-style-type: none"> If it is due to excessive low speeds or very low feed rates, select an adhesion resistant grade. If it is due to thermal cracking, select a thermal impact resistant grade. 	- Recommended insert grades <table border="1"> <thead> <tr> <th></th> <th>Steel</th> <th>Cast Iron</th> </tr> </thead> <tbody> <tr> <td>Roughing</td> <td>ACP300 (Coated Carbide)</td> <td>ACK300 (Coated Carbide)</td> </tr> </tbody> </table>					Steel	Cast Iron	Roughing	ACP300 (Coated Carbide)	ACK300 (Coated Carbide)							
	Steel	Cast Iron																	
Roughing	ACP300 (Coated Carbide)	ACK300 (Coated Carbide)																	
Others	Unsatisfactory Machined Surface Finish	Tool Material	<ul style="list-style-type: none"> Select an adhesion resistant grade. Carbide → Cermet 	- Recommended insert grades <table border="1"> <thead> <tr> <th></th> <th>Steel</th> <th>Cast Iron</th> <th>Non-Ferrous Alloy</th> </tr> </thead> <tbody> <tr> <td>Roughing</td> <td>WGX type* ACP200 (Coated Carbide)</td> <td>DGC type* ACK200 (Coated Carbide)</td> <td>FF type* H1 (Carbide) DL1000 (Coated Carbide)</td> </tr> <tr> <td>Finishing</td> <td>WGC type T250A (Cermet)</td> <td>FMU type BN700 (SUMIBORON)</td> <td>RF type DA1000 (SUMIDIA)</td> </tr> </tbody> </table>					Steel	Cast Iron	Non-Ferrous Alloy	Roughing	WGX type* ACP200 (Coated Carbide)	DGC type* ACK200 (Coated Carbide)	FF type* H1 (Carbide) DL1000 (Coated Carbide)	Finishing	WGC type T250A (Cermet)	FMU type BN700 (SUMIBORON)	RF type DA1000 (SUMIDIA)
		Steel	Cast Iron	Non-Ferrous Alloy															
	Roughing	WGX type* ACP200 (Coated Carbide)	DGC type* ACK200 (Coated Carbide)	FF type* H1 (Carbide) DL1000 (Coated Carbide)															
	Finishing	WGC type T250A (Cermet)	FMU type BN700 (SUMIBORON)	RF type DA1000 (SUMIDIA)															
	Chattering	Cutting Conditions	<ul style="list-style-type: none"> Increase cutting speeds. 	- Recommended cutters: For steel: WaveMill WGX type For cast iron: DNX type For Non-ferrous alloy: High speed cutter for aluminium RF type															
Unsatisfactory Chip Control	Tool Design	<ul style="list-style-type: none"> Improve axial run-out of cutting edges. (Use a cutter with less run-out) (Attach correct inserts) Use wiper inserts. Use special purpose cutters designed for finishing. 	- Recommended cutter: WaveMill WGX type																
Edge Chipping on Workpiece	Tool Design	<ul style="list-style-type: none"> Select a large approach angle. Select a sharp cutting edge insert (G → L). Reduce feed rates. 	- Recommended cutter: WaveMill WGX type																
Burr on Workpiece	Tool Design	<ul style="list-style-type: none"> Select a cutter with sharp cutting edges. Increase feed rates. 	- Recommended cutter: WaveMill WGX type + FG breaker DGC type + FG breaker																

Technical Guidance

Basics of Endmilling

Parts of an Endmill



Calculating Cutting Conditions

● Cutting speed

$$v_c = \frac{\pi \cdot D \cdot n}{1.000} \quad n = \frac{1.000 \cdot v_c}{\pi \cdot D}$$

● Feed rate

$$v_f = f \times n$$

$$v_f = f_t \times z \times n \quad f_t = \frac{v_f}{z \times n}$$

● Depth of cut (D.O.C)

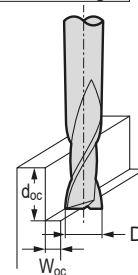
d_{oc} : Axial D.O.C. (depth)
 w_{oc} : Radial D.O.C. (width)

● Notch width (D_1)

$$D_1 = 2 \times \sqrt{2 \times R \times d_{oc} - d_{oc}^2}$$

● Cutting speed and feedrate are calculated using the same formula as square endmill.

Side milling



v_c : Cutting speed (m/min)

$\pi \approx 3,14$

D : Endmill diameter (mm)

n : Rotational speed (min^{-1})

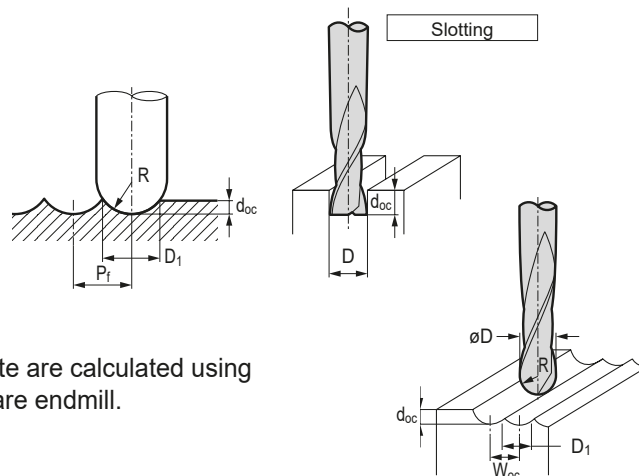
v_f : Feed speed (mm/min)

f_r : Feed rate per revolution (mm/rev)

f_t : Feed rate per tooth (mm/tooth)

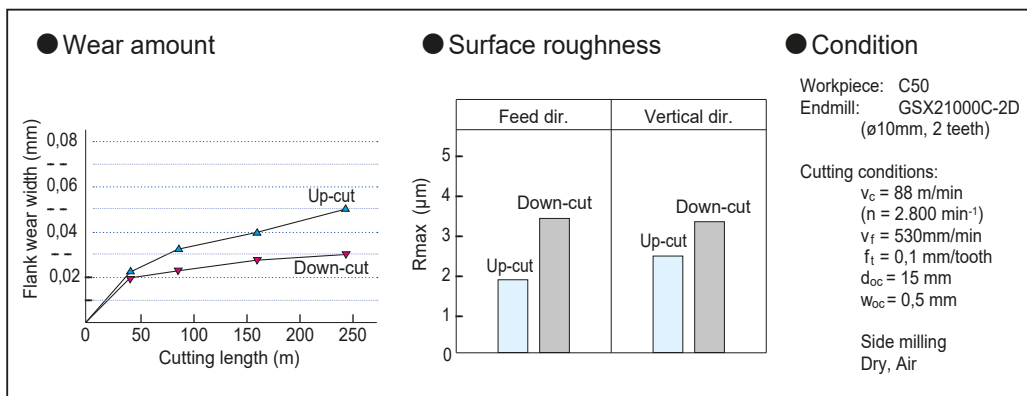
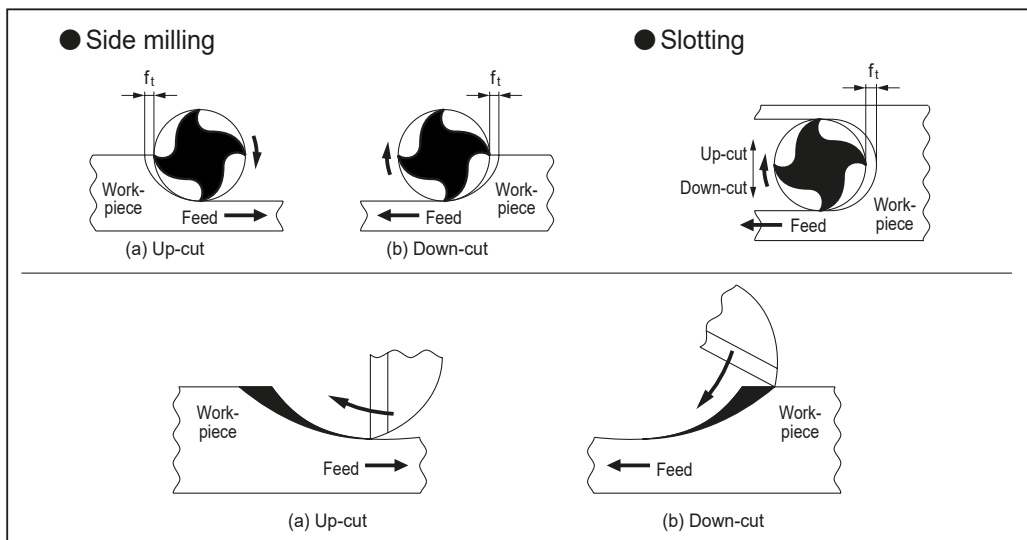
z : Number of teeth

Slotting



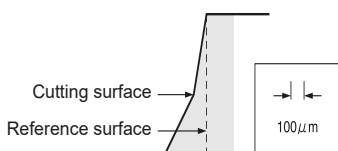
(Ball Endmill)

Up-cut and Down-cut



Relation Between Cutting Condition and Deflection

Endmill			Side milling		Slotting					
			Work material: Pre-hardened steel (40HRC) Cutting data: $v_c = 25 \text{ m/min}$ $d_{oc} = 12 \text{ mm}$ $W_{oc} = 0,8 \text{ mm}$		Work material: Pre-hardened steel (40HRC) Cutting data: $v_c = 25 \text{ m/min}$ $d_{oc} = 8 \text{ mm}$ $W_{oc} = 8 \text{ mm}$					
Cat. No.	Number of teeth	Helix angle	Feed rate		Feed rate		Feed rate		Feed rate	
			0,16 mm/rev		0,11 mm/rev		0,05 mm/rev		0,03 mm/rev	
			Style		Style		Style		Style	
			Up-cut	Down-cut	Up-cut	Down-cut	Up-cut	Down-cut	Up-cut	Down-cut
SSM 2080	2	30°								
SSM 4080	4	30°								



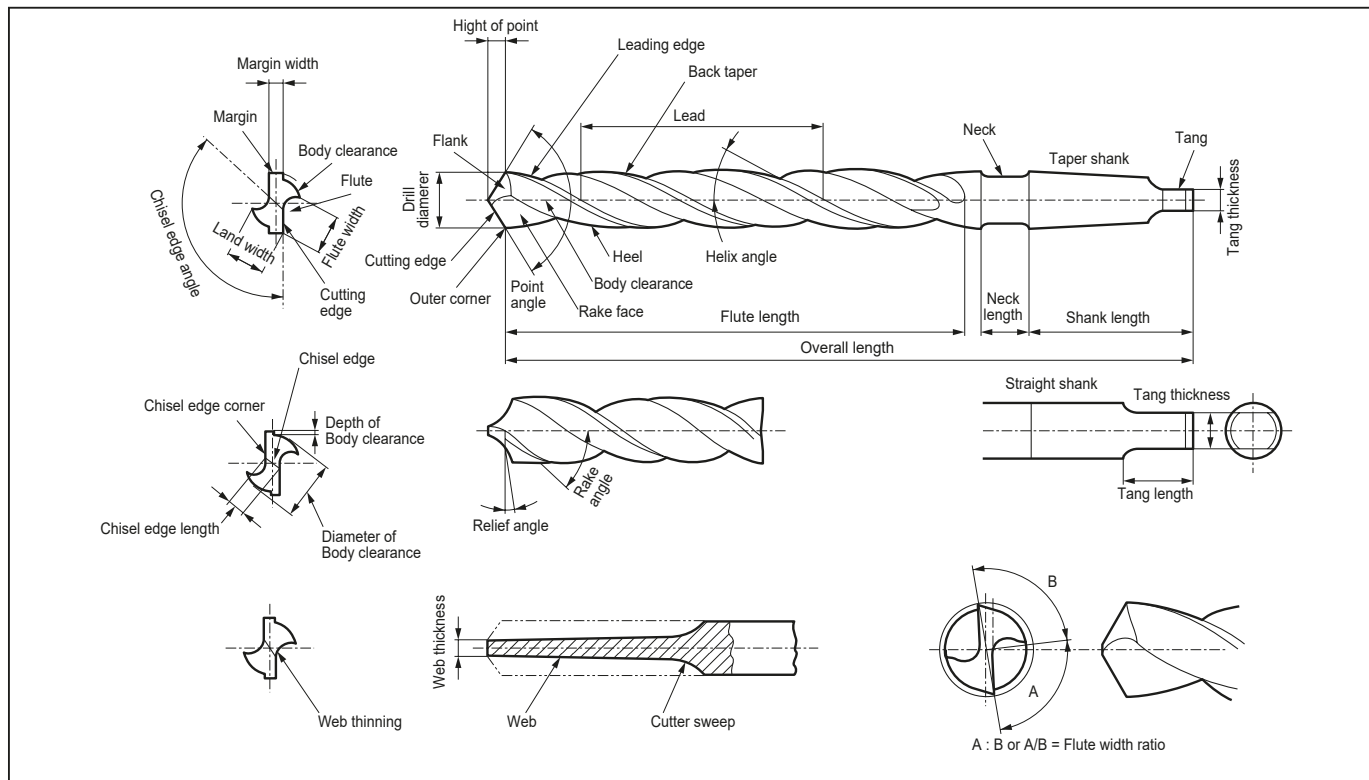
Technical Guidance

Tool Failure and Remedies

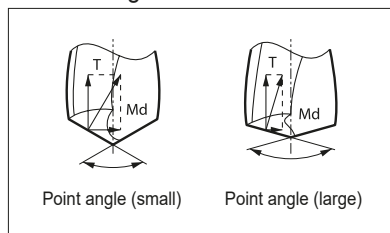
■ Trouble Shooting Guide for Endmilling

Failure		Cause		Remedies
Cutting Edge Failure	Excessive Wear	Cutting Conditions Tool Shape Tool Material	<ul style="list-style-type: none"> - Cutting speed is too fast - Feed rate is too fast - The flank relief angle ist too small - Insufficient wear resistance 	<ul style="list-style-type: none"> - Decrease cutting speed and feed rate. - Change to an appropriate flank relief angle. - Select a substrate with more wear resistance - Use a coated tool
	Chipping	Cutting Conditions Machine Area	<ul style="list-style-type: none"> - Feed rate ist too fast - Cutting depth is too deep - Tool overhang ist too long - Work clamps are weak - Tool is not firmly attached 	<ul style="list-style-type: none"> - Decrease cutting speed. - Reduce depth of cut - Adjust tool overhang for correct length - Clamp the work piece firmly - Make sure the tool is seated in the chuck properly
	Tool Fracture	Cutting Conditions	<ul style="list-style-type: none"> - Feed rate ist too fast - Cutting depth is too deep - Tool overhang ist too long - Cutting edge is too long 	<ul style="list-style-type: none"> - Decrease cutting speed. - Reduce depth of cut - Reduce tool overhang as much as possible - Select a tool with a shorter cutting edge
Others	Shoulder Deflection	Cutting Conditions Tool Shape	<ul style="list-style-type: none"> - Feed rate is too fast - Cutting depth is too deep - Tool overhang is too long - Cutting on the down-cut - Helix angle is large 	<ul style="list-style-type: none"> - Decrease cutting speed. - Reduce depth of cut - Adjust tool overhang for correct length - Change directions to up-cut - Use a tool with a smaller helix angle
	Unsatisfactory Machined Surface Finish	Cutting Conditions	<ul style="list-style-type: none"> - Feed rate is too fast - Packing of chips 	<ul style="list-style-type: none"> - Decrease cutting speed. - Use air blow - Use an insert with a larger relief pocket.
	Chattering	Cutting Conditions Tool Shape Machine Area	<ul style="list-style-type: none"> - Cutting speed is too fast - Cutting on the up-cut - Tool overhang is too long - Rake angle is large - Work clamps are weak - Tool is not firmly attached 	<ul style="list-style-type: none"> - Decrease cutting speed. - Change directions to down-cut - Adjust tool overhang for correct length - Use a tool with an appropriate rake angle - Clamp the work piece firmly - Make sure the tool is seated in the chuck properly
	Packing of Chip	Cutting Conditions Tool Shape	<ul style="list-style-type: none"> - Feed rate is too fast - Cutting depth is too deep - Too many teeth - Packing of chips 	<ul style="list-style-type: none"> - Decrease cutting speed. - Reduce depth of cut - Reduce number of teeth - Use air blow

Parts of a Drill

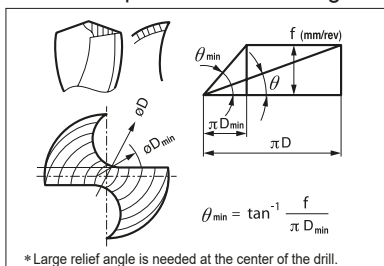


Point Angle and Force



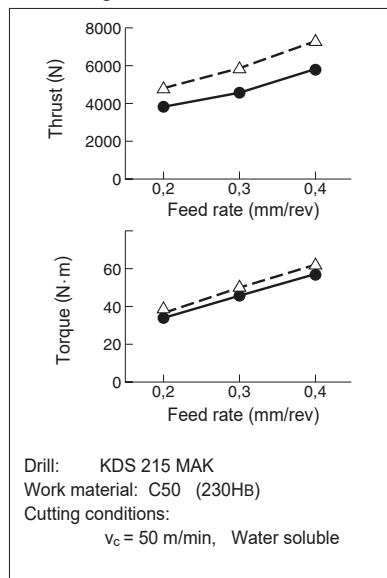
When point angle is large, thrust becomes large but torque becomes small.

Min. Requirement Relief Angle

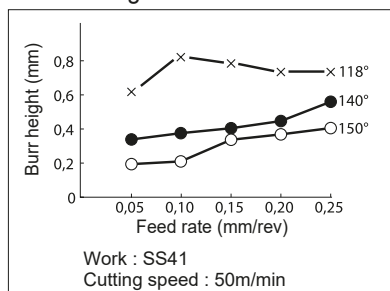


* Large relief angle is needed at the center of the drill.

Width of Edge Treatment and Cutting Force

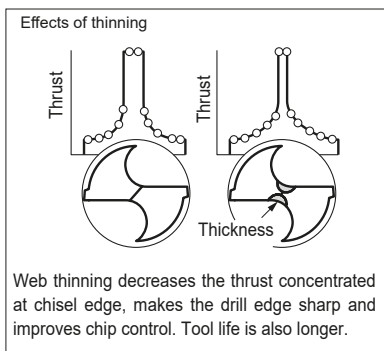


Point Angle and Burr

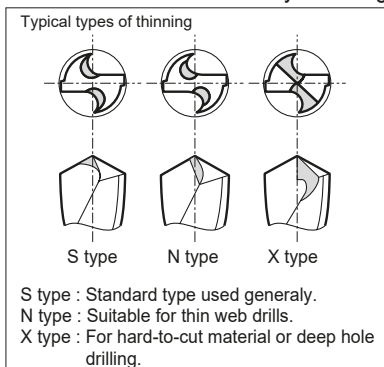


When point angle is large, burr height becomes low.

Web Thickness and Thrust



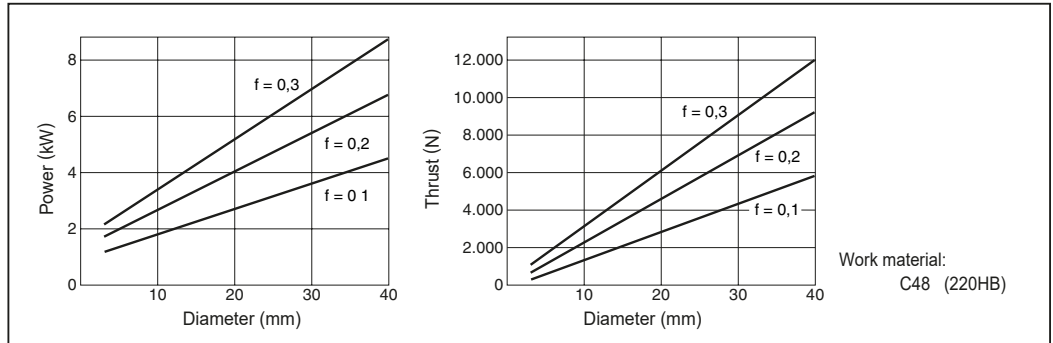
Decrease Chisel Width by Thinning



Technical Guidance

Basics of Drilling

Reference of Power Requirement and Thrust



Cutting Condition Selection

- Control cutting force for low rigid machine

The following table shows the relation between edge treatment width and cutting force. If a problem caused by cutting force occurs, reduce either the feedrate or the edge treatment width.

Condition		Edge treatment width			
		0,15mm		0,05mm	
V_c (m/min)	f (mm/rev)	Torque (N•m)	Thrust (N)	Torque (N•m)	Thrust (N)
40	0,38	12,8	2820	12,0	2520
50	0,30	10,8	2520	9,4	1920
60	0,25	9,2	2320	7,6	1640
60	0,15	6,4	1640	5,2	1.100

Drill : $\phi 10$
Work material: C50 (230HB)

- High speed machining recommendation

When there is surplus capacity with enough machine power and rigidity drilling at normal recommended cutting conditions, we recommend higher drilling speeds.

Wear example

Work material: C50 (230HB)
Cutting data: $f = 0,3$ mm/rev
 $d_{oc} = 50$ mm
Tool life: 600 holes (Cutting length : 30m)

Explanation of Margins (Difference between single and double margins)

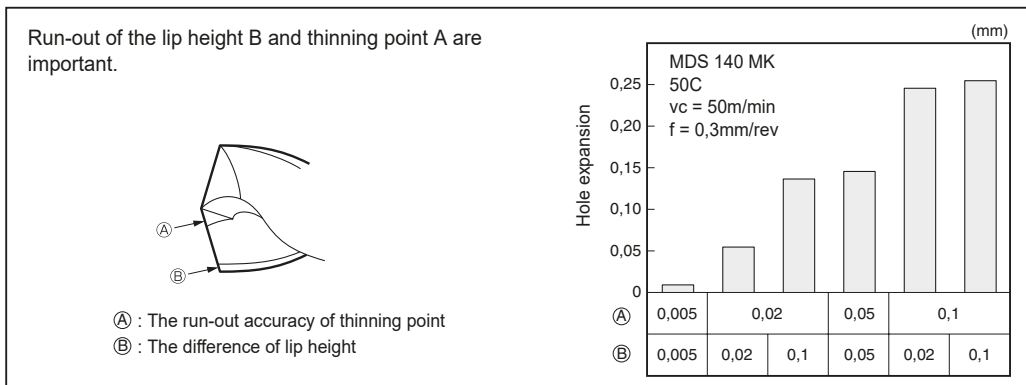
● Single Margin (2 guides: circled parts)

● Shape used on most drills

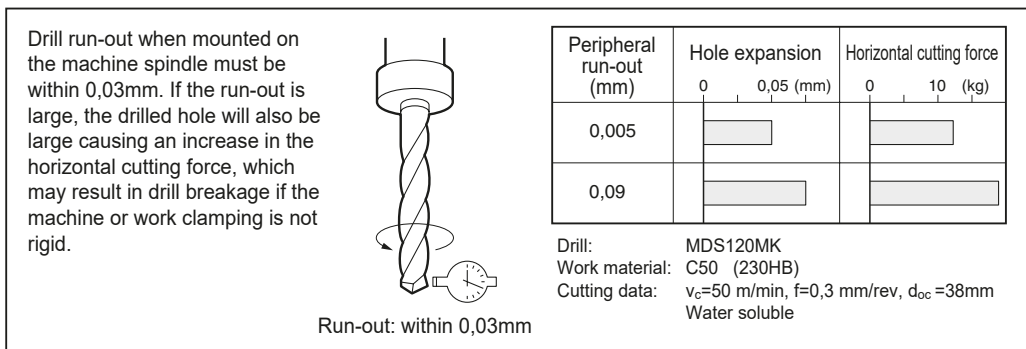
● D Double Margin (4 guides: circled parts)

● 4-point guiding reduces hole bending and undulation for improved stability and accuracy during deep hole drilling.

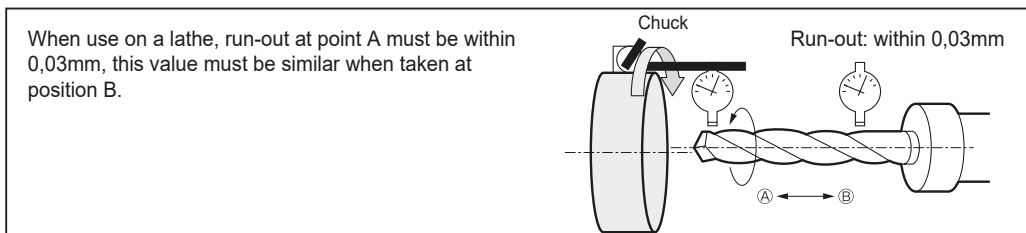
Run-out Accuracy



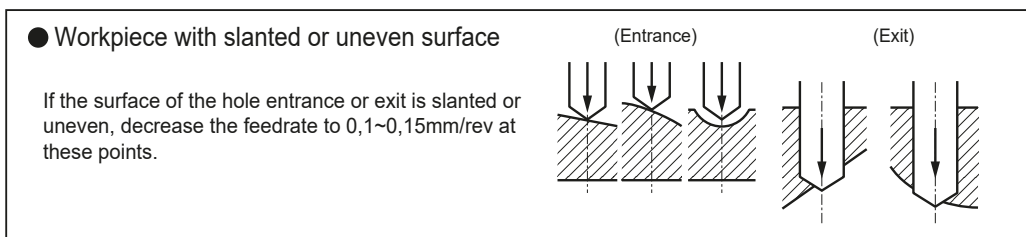
Peripheral Run-out Accuracy when Tool Rotates



Peripheral Run-out Accuracy when Workpiece Rotates

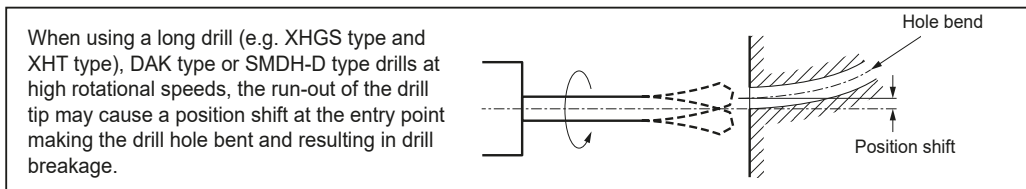


Influence of Workpiece Surface

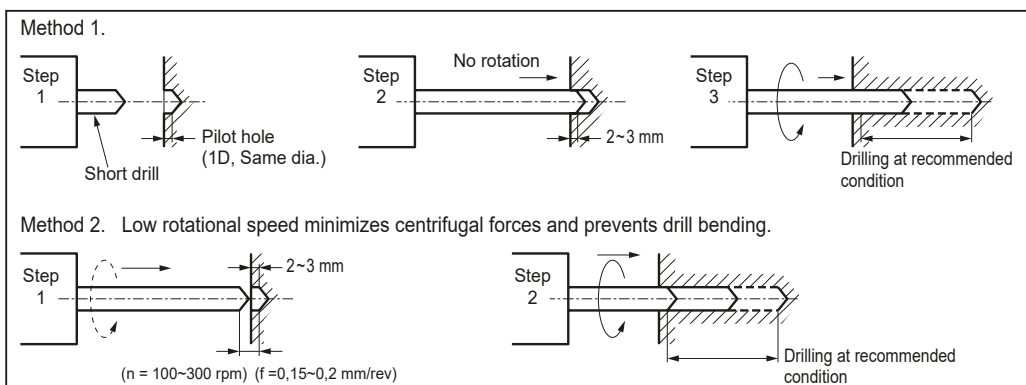


How to Use Long Drill

● Problem



● Remedies



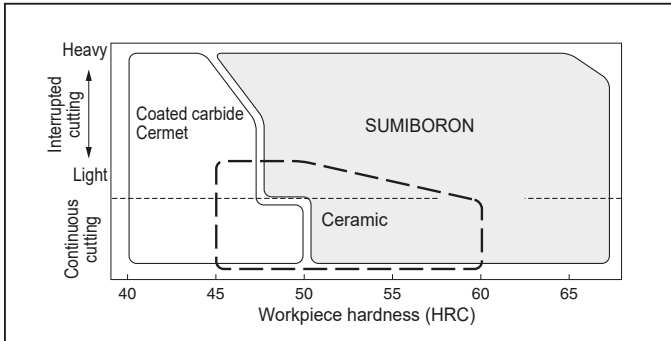
Technical Guidance

Tool Failure and Remedies

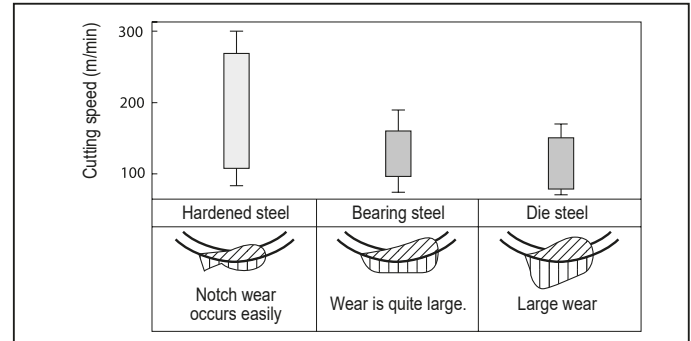
■ Trouble Shooting Guide for Drilling

Failure		Basic Remedies		Remedies Examples
Drill Failure	Excessive Wear on Cutting Edge	Cutting Conditions Cutting Fluid	- Use higher cutting speeds. - Increase feed rates. - Reduce pressure if using internal coolant. - Use cutting fluid with more lubricity.	- $V_c=80\sim 100\text{m/min}$ - Refer to recommended cutting conditions listed in the general catalogue. - Below 1,5MPa.
	Chisel Point Chipping	Tool Design Cutting Conditions Others	- Increase size of chisel width. - Increase amount of honing on cutting edge. - Reduce depth-of cut. - Reduce feed rate at entry point. - Improve workpiece clamping rigidity.	- $f = 0,05\sim 0,1 \text{ mm/rev}$
	Chipping on Peripheral Cutting Edge	Tool Design Cutting Conditions Cutting Fluid Others	- Increase amount of honing on cutting edge. - Reduce the amount of front flank angle. - Reduce cutting speeds. - Increase feed rates. - Use cutting fluid with more lubricity. - Improve workpiece clamp rigidity.	- Refer to recommended cutting conditions listed in the general catalogue.
	Margin Wear	Tool Design Cutting Conditions Cutting Fluid Others	- Increase amount of back taper. - Reduce margin width. - Reduce cutting speeds. - Increase feed rates. - Use cutting fluid with more lubricity. - Schedule for earlier regrind.	- Refer to recommended cutting conditions listed in the general catalogue.
	Drill Breakage	Tool Design Cutting Conditions Cutting Fluid Others	- Increase amount of back taper. - Reduce margin width. - Reduce cutting speeds. - Use cutting fluid with more lubricity. - Improve workpiece clamp rigidity.	- Refer to recommended cutting conditions listed in the general catalogue.
Unsatisfactory Hole Accuracy	Oversized Holes	Tool Design Cutting Conditions Cutting Fluid Others	- Improve overall drill rigidity. (large web, small flute). - Reduce drill point angle. - Reduce feed rate at entry phase. - Reduce cutting speeds. - Improve workpiece clamp rigidity. - Improve drill clamp precision. - Improve drill clamp rigidity.	- $130^\circ\sim 120^\circ$ - $f = 0,05\sim 0,1 \text{ mm/rev}$ - Refer to recommended cutting conditions listed in the general catalogue. - Drill run-out below 0,02mm
	Poor Surface Finish	Tool Design Cutting Conditions Cutting Fluid	- Increase amount of back taper. - Increase cutting speeds. - Use cutting fluid with more lubricity.	- Refer to recommended cutting conditions listed in the general catalogue.
	Holes are Not Straight	Tool Design Cutting Conditions Others	- Reduce amount of edge honing. - Reduce feedrates. - Improve workpiece clamp rigidity. - Improve drill clamp precision. - Improve drill clamp rigidity.	- Refer to recommended cutting conditions listed in the general catalogue. - Drill run-out below 0,02mm
Unsatisfactory Chip Control	Packing of Chips	Cutting Conditions Cutting Fluid	- Increase cutting speeds. - Increase feed rates. - Reduce pressure if using internal coolant.	- Refer to recommended cutting conditions listed in the general catalogue. - Below 1,5MPa.
	Long Stringy Chips	Tool Design Cutting Conditions Cutting Fluid	- Reduce amount of edge honing. - Increase feed rates. - Reduce pressure if using internal coolant.	- Refer to recommended cutting conditions listed in the general catalogue. - Below 1,5MPa.

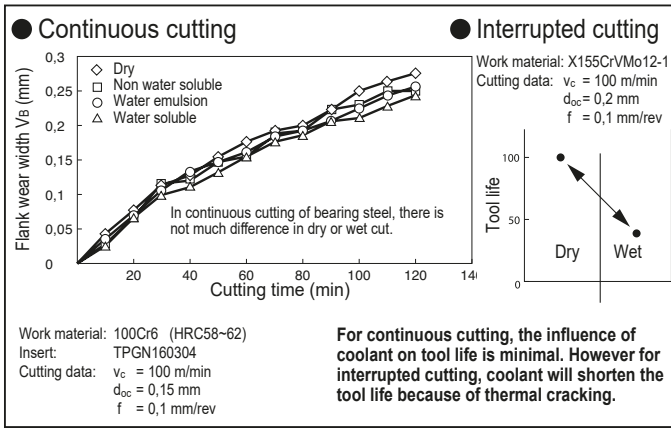
Application Map of the Various Tool Materials



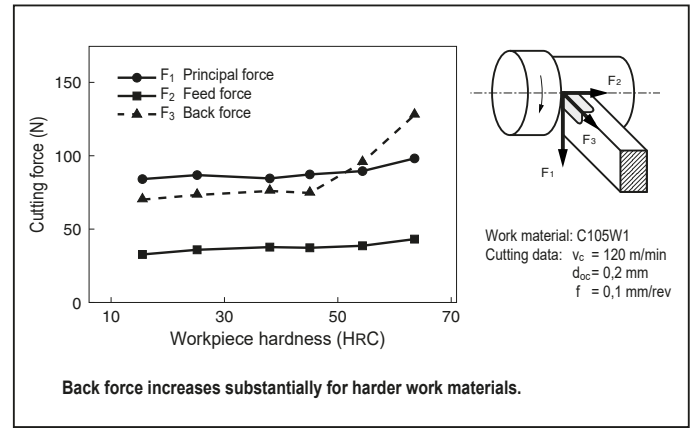
Work Materials and Cutting Speed Recommendations



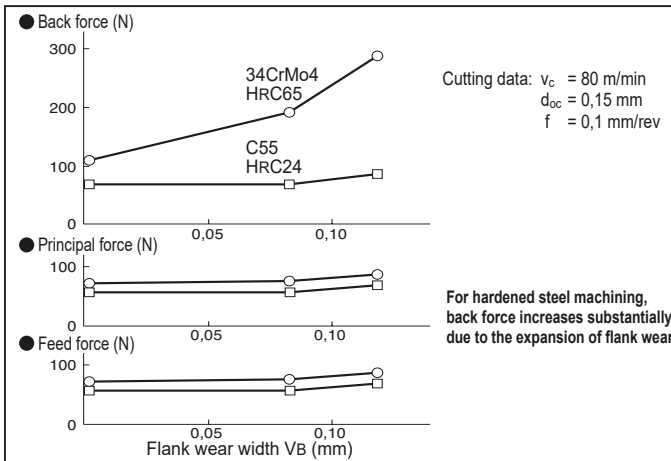
Influence of Coolant on Tool Life



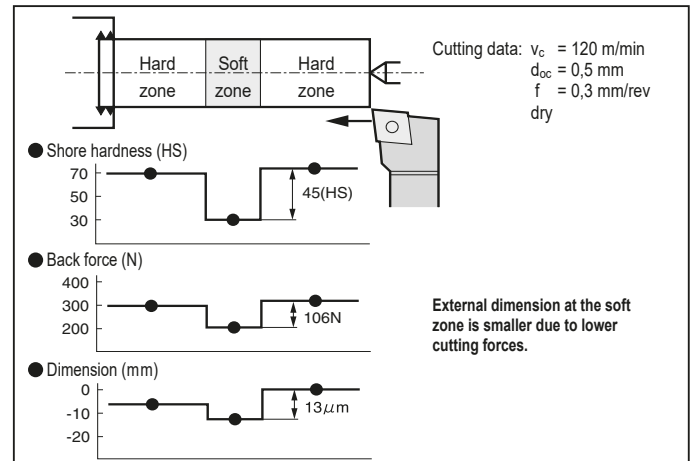
Relation Workpiece Hardness and Cutting Forces



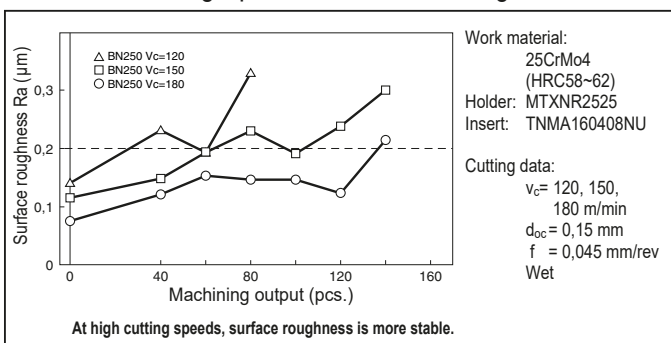
Relation between Flank Wear and Cutting Force



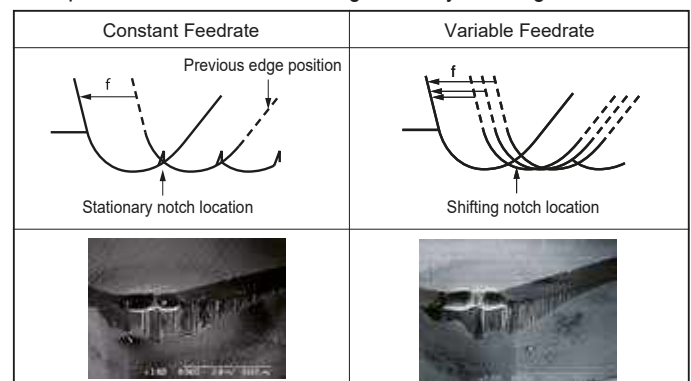
Workpiece Hardness on Cutting Force and Accuracy



Relation Cutting Speed and Surface Roughness

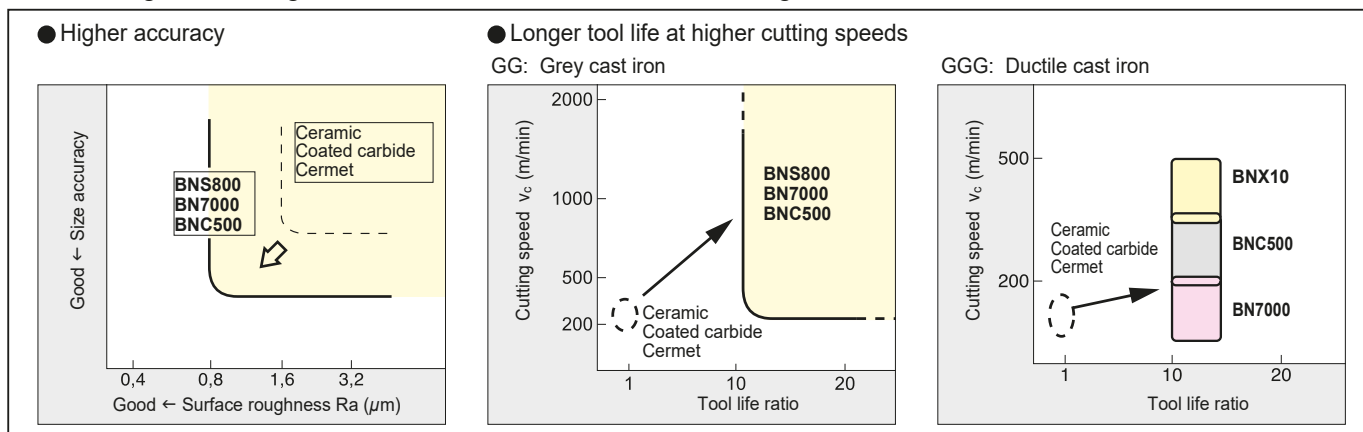


Improvement of Surface Roughness by Altering the Feedrate



Varying the feedrate spreads the notch location over a larger area, surface finish improves and notch wear decreases.

Advantages of Using SUMIBORON for Cast Iron Machining

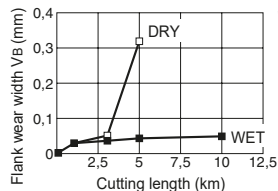


Turning

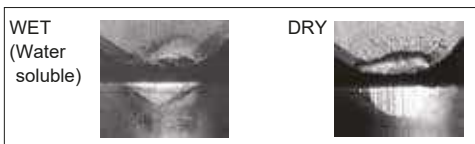
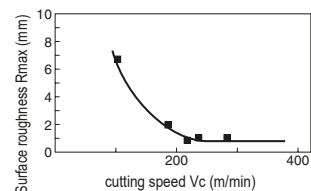
Cast iron structure and wear shape examples

		GG	GGG
Structure	Matrix		
		Pearlite	Pearlite + Ferrite
Tool wear shape	Wet		
	Dry		

($v_c \geq 200$ m/min)



Work material: GG25
 Insert: SNGN120408(BN500)
 Cutting data: $v_c = 450$ m/min
 $d_{oc} = 0,25$ mm
 $f = 0,15$ mm/rev
 Continuous cutting



For machining cast iron with SUMIBORON, cutting speeds (V_c) should be 200m/min and above. WET cutting is recommended.

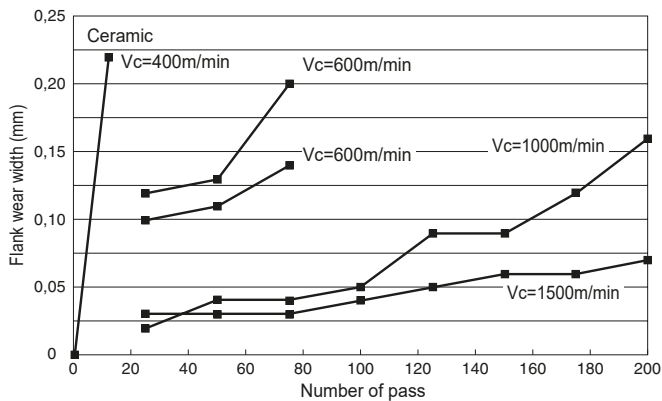
Machine: N/C lathe
 Work material: GG25 (HB200)
 Holder: MTJNP2525
 Insert: TNMA160408(BN500)
 Cutting data: $v_c = 110-280$ m/min
 $d_{oc} = 0,1$ mm
 $f = 0,1$ mm/rev
 WET

Milling

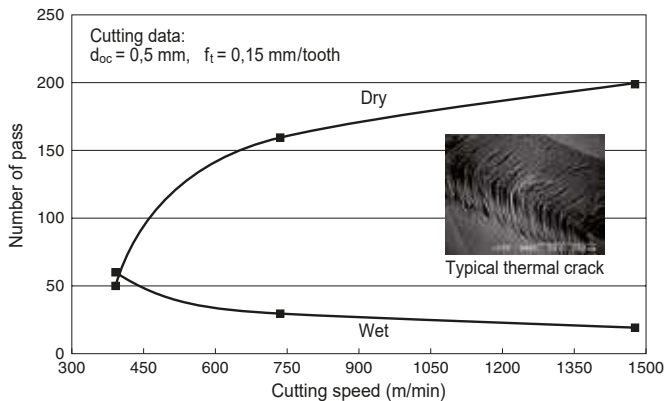
SUMIBORON BN Finish Mill EASY



- High speed machining $V_c = 2000$ m/min
- Surface Roughness $R_z=3,2$ ($R_a=1,0$)
- Running cost is reduced because of economical insert
- Easy insert setting with the aid of a setting gauge
- Safe, anti-centrifugal force construction for high speed conditions



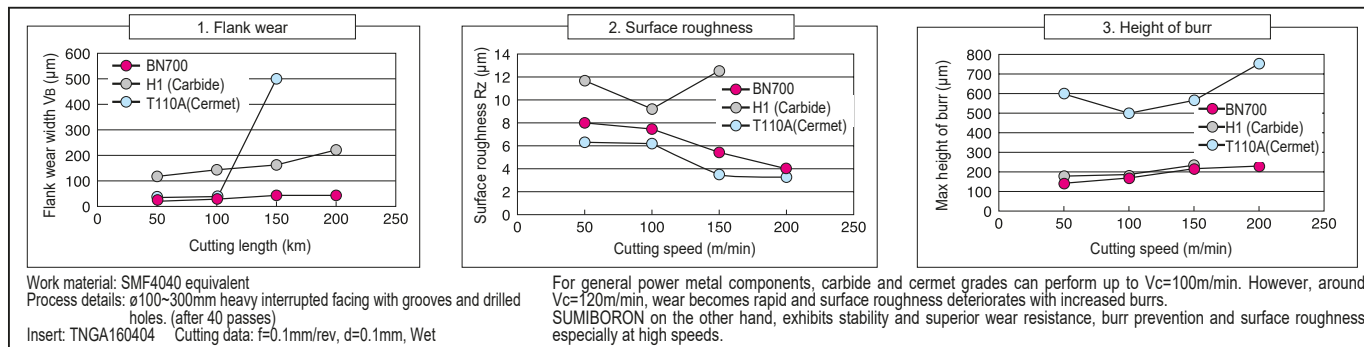
Work material: GG25
 Tool material: BN700
 Cutting data: $d_{oc} = 0,5$ mm, $f_t = 0,1$ mm/tooth, DRY



Typical thermal crack

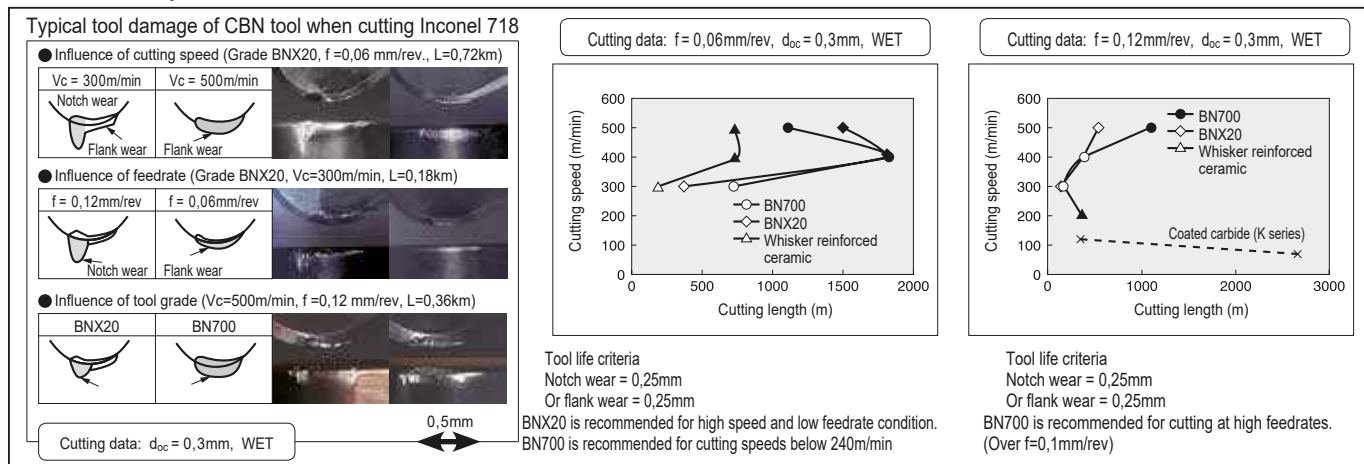
Dry cutting is recommended for high speed milling of cast iron with SUMIBORON.

■ Powder Metal

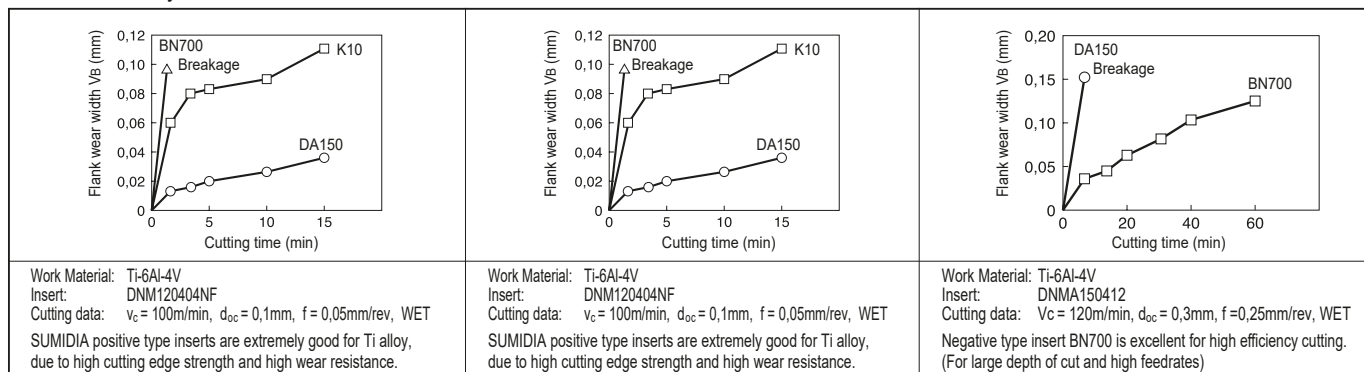


■ Heat Resistant Alloy

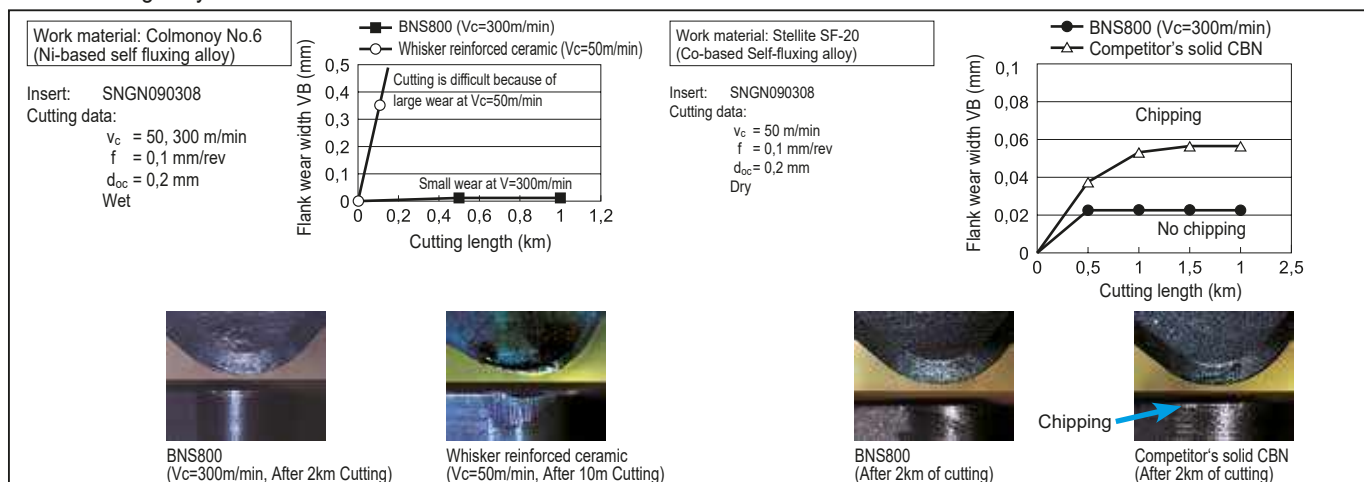
● Ni based alloy











● Ti based alloy



● Hard facing alloys



		Damage	Remedies
Cutting Edge Failure		<p>Large flank wear</p> 	<p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> <ul style="list-style-type: none"> ☞ Select a more wear resistant grade. ☞ Reduce the cutting force. ☞ Reduce the NL width and angle. ☞ Positive inserts preferred ☞ Check the cutting speed. ☞ Reduce the cutting speed to less than 200m/min. ☞ Higher feed rate reduces the overall tool-to-work contact time.
		<p>Large crater wear</p> 	<p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> <ul style="list-style-type: none"> ☞ Crater wear resistant grades are recommended. Continuous ~ Light interrupted cutting = BNC2010 Light ~ Medium interrupted cutting = BNX20 Medium ~ Heavy interrupted cutting = BNX25 ☞ Determine the cutting edge geometry after inspecting the used inserts closely. ☞ Sharpen the cutting edge to prevent crater wear. ☞ Strengthen the cutting edge to prevent crater breakage. ☞ Check the cutting speed. ☞ Reduce the cutting speed to less than 200m/min. ☞ Higher feed rates are recommended.
		<p>Breakage at bottom of crater</p> 	
		<p>Flaking</p> 	<p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> <ul style="list-style-type: none"> ☞ Flaking is caused by high back forces and back force is related to flank wear. ☞ Select a more wear resistant grade. ☞ A sharper cutting edge helps prevent flaking. ☞ Reduce the NL angle and width ☞ Positive inserts preferred ☞ Reduce flank wear with lower speed and higher feed rates. ☞ Reducing tool-to-work contact time effectively reduces flank wear.
		<p>Chipping at notch position</p> 	<p>Cutting condition</p> <ul style="list-style-type: none"> ☞ If surface finish is affected, consider using the "Variable Feed rate" method to improve finishing. ☞ For other cases, use remedies similar to that for normal wear.
		<p>Chipping at notch position</p> 	<p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> <ul style="list-style-type: none"> ☞ Caused by impact shocks to the cutting edge. Chattering may also be a contributing factor. ☞ Select a tougher grade. ☞ Strengthen the cutting edge. ☞ Large NL angle, Honing. ☞ Higher feed rates are recommended to lessen the number of impacts.
		<p>Chipping at nose position</p> 	<p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> <ul style="list-style-type: none"> ☞ Caused by impact shocks to the cutting edge. Chattering may also be a contributing factor. ☞ Select a tougher grade. ☞ Strengthen the cutting edge. ☞ Large NL angle, Honing. ☞ Higher feedrates are recommended to lessen the number of impacts.
		<p>Thermal crack</p> 	<p>Cutting condition</p> <p>Tool design</p> <p>Tool material</p> <ul style="list-style-type: none"> ☞ Thermal shocks generate vertical crack lines across the cutting edge. Completely dry condition is recommended. ☞ If dry condition machining is already observed, then reduction of cutting temperatures and cutting force is necessary. ☞ Decrease cutting speed, feedrate, depth of cut. ☞ Sharpen cutting edge. ☞ Select more thermal conductivity grade.

■ Steel and Non-Ferrous Metal Symbols Chart

● Carbon Steels

JIS	AISI	DIN
S10C	1010	C10
S15C	1015	C15
S20C	1020	C22
S25C	1025	C25
S30C	1030	C30
S35C	1035	C35
S40C	1040	C40
S45C	1045	C45
S50C	1049	C50
S55C	1055	C55

● Ni-Cr-Mo Steels

JIS	AISI	DIN
SNCM220	8620	21NiCrMo2
SNCM240	8640	—
SNCM415	—	—
SNCM420	4320	—
SNCM439	4340	40NiCrMo6
SNCM447	—	34NiCrMo6

● Cr Steels

JIS	AISI	DIN
SCr415	—	15CrMo5
SCr420	5120	20Cr4
SCr430	5130	34Cr4
SCr435	5132	37Cr4
SCr440	5140	41Cr4
SCr445	5147	—

● Cr-Mo Steels

JIS	AISI	DIN
SCM415	—	15CrMo5
SCM420	—	20CrMo5
SCM430	4131	25CrMo4
SCM435	4137	34CrMo4
SCM440	4140	42CrMo4
SCM445	4145	—

● Mn Steels and Mn-Cr Steels for Structural Use

JIS	AISI	DIN
SMn420	1522	—
SMn433	1534	—
SMn438	1541	—
SMn443	1541	—
SMnC420	—	—
SMnC443	—	—

● Cr-Mo Steels

JIS	AISI	DIN
SK1	—	—
SK2	W1-11 1/2	—
SK3	W1-10	C105W1
SK4	W1-9	—
SK5	W1-8	C80W1
SK6	—	C80W1
SK7	—	C70W2

● High Speed Steels

JIS	AISI	DIN
SKH2	T1	—
SKH3	T4	S18-1-2-5
SKH10	T15	S12-1-4-5
SKH51	M2	S6-5-2
SKH52	M3-1	—
SKH53	M3-2	S6-5-3
SKH54	M4	—
SKH56	M36	—

● Alloy Tool Steels

JIS	AISI	DIN
SKS11	F2	—
SKS51	L6	—
SKS43	W2-9 1/2	—
SKD1	D3	X210Cr12
SKD11	D2	X155CrVMo12-1
SKD61	—	X40CrVMo5-1

● Grey Cast Iron

JIS	AISI	DIN
FC100	No 20B	GG-10
FC150	No 25B	GG-15
FC200	No 30B	GG-20
FC250	No 35B	GG-25
FC300	No 45B	GG-30
FC350	No 50B	GG-35

● Nodular Cast Iron

JIS	AISI	DIN
FCD400	60-40-18	GGG-40
FCD450	—	GGG-40.3
FCD500	80-55-06	GGG-50
FCD600	—	GGG-60
FCD700	100-70-03	GGG-70

● Ferritic Stainless Steels

JIS	AISI	DIN
SUS405	405	X10CrAl13
SUS429	429	—
SUS430	430	X6Cr17
SUS430F	430F	X7CrMo18
SUS434	434	X6CrMo17 1

● Martensitic Stainless Steels

JIS	AISI	DIN
SUS403	403	—
SUS410	410	X10Cr13
SUS416	416	—
SUS420JI	420	X20Cr13
SUS420F	420F	—
SUS431	431	X20CrNi17 2
SUS440A	440A	—
SUS440B	440B	—
SUS440C	440C	—

● Austenitic Stainless Steels

JIS	AISI	DIN
SUS201	201	—
SUS202	202	—
SUS301	301	X12CrNi17 7
SUS302	302	—
SUS302B	302B	—
SUS303	303	X10CrNiS18 9
SUS303Se	303Se	—
SUS304	304	X5CrNiS18 10
SUS304L	304L	X2CrNi19 11
SUS304NI	304N	—
SUS305	305	X5CrNi18 12
SUS308	308	—
SUS309S	309S	—
SUS310S	310S	—
SUS316	316	X5CrMo17 12 2
SUS316L	316L	X2CrNiMo17 13 2
SUS316N	316N	—
SUS317	317	—
SUS317L	317L	X2CrNiMo18 16 4
SUS321	321	X6CrNiTi18 10
SUS347	347	X6CrNiNb18 10
SUS384	384	—

● Heat Resisting Steels

JIS	AISI	DIN
SUH31	—	—
SUH35	—	—
SUH36	—	X53CrMnNi21 9
SUH37	—	—
SUH38	—	—
SUH309	309	—
SUH310	310	CrNi2520
SUH330	N08330	—

● Ferritic Heat Resisting Steels

JIS	AISI	DIN
SUH21	—	CrAl1205
SUH409	409	X6CrTi12
SUH446	446	—

● Martensitic Heat Resisting Steels

JIS	AISI	DIN
SUH1	—	X45CrSi9 3
SUH3	—	—
SUH4	—	—
SUH11	—	—
SUH600	—	—

References

■ Hardness Scale Comparison Chart

● Approx. metric value and Brinell hardness of steel

Brinell Hardness 10mm Ball 3.000kgf (HB)	Rockwell Hardness				Vickers Hardness 50kgf (HV)	Shore Hardness (HS)	Traverse Rupture Strength (N/mm ²)
	„A“ Scale Diamond, brale 60kgf (HRA)	„B“ Scale 100kgf 1/10" Ball (HRB)	„C“ Scale Diamond, brale 150kgf (HRC)	„D“ Scale Diamond, brale 100kgf (HRD)			
—	85,6	—	68,0	76,9	940	97	—
—	85,3	—	67,5	76,5	920	96	—
—	85,0	—	67,0	76,1	900	95	—
767	84,7	—	66,4	75,7	880	93	—
757	84,4	—	65,9	75,3	860	92	—
745	84,1	—	65,3	74,8	840	91	—
733	83,8	—	64,7	74,3	820	90	—
722	83,4	—	64,0	73,8	800	88	—
712	—	—	—	—	—	—	—
710	83,0	—	63,3	73,3	780	87	—
698	82,6	—	62,5	72,6	760	86	—
684	82,2	—	61,8	72,1	740	—	—
682	82,2	—	61,7	72,0	737	84	—
670	81,8	—	61,0	71,5	720	83	—
656	81,3	—	60,1	70,8	700	—	—
653	81,2	—	60,0	70,7	697	81	—
647	81,1	—	59,7	70,5	690	—	—
638	80,8	—	59,2	70,1	680	80	—
630	80,6	—	58,8	69,8	670	—	—
627	80,5	—	58,7	69,8	667	79	—
601	79,8	—	57,3	68,7	640	77	—
578	79,1	—	56,0	67,7	615	75	—
555	78,4	—	54,7	66,7	591	73	2055
534	77,8	—	53,5	65,8	569	71	1985
514	76,9	—	52,1	64,7	547	70	1890
495	76,3	—	51,0	63,8	528	68	1820
477	75,6	—	49,6	62,7	508	66	1730
461	74,9	—	48,5	61,7	491	65	1670
444	74,2	—	47,1	60,8	472	63	1585
429	73,4	—	45,7	59,7	455	61	1510
415	72,8	—	44,5	58,8	440	59	1460
401	72,0	—	43,1	57,8	425	58	1390
388	71,4	—	41,8	56,8	410	56	1330
375	70,6	—	40,4	55,7	396	54	1270
363	70,0	—	39,1	54,6	383	52	1220
352	69,3	(110,0)	37,9	53,8	372	51	1180
341	68,7	(109,0)	36,6	52,8	360	50	1130
331	68,1	(108,5)	35,5	51,9	350	48	1095

Brinell Hardness 10mm Ball 3.000kgf (HB)	Rockwell Hardness				Vickers Hardness 50kgf (HV)	Shore Hardness (HS)	Traverse Rupture Strength (N/mm ²)
	„A“ Scale Diamond, brale 60kgf (HRA)	„B“ Scale 100kgf 1/10" Ball (HRB)	„C“ Scale Diamond, brale 150kgf (HRC)	„D“ Scale Diamond, brale 100kgf (HRD)			
321	67,5	(108,0)	34,3	50,1	339	47	1060
311	66,9	(107,5)	33,1	50,0	328	46	1025
302	66,3	(107,0)	32,1	49,3	319	45	1005
293	65,7	(106,0)	30,9	48,3	309	43	970
285	65,3	(105,5)	29,9	47,6	301	—	950
277	64,6	(104,5)	28,8	46,7	292	41	925
269	64,1	(104,0)	27,6	45,9	284	40	895
262	63,6	(103,0)	26,6	45,0	276	39	875
255	63,0	(102,0)	25,4	44,2	269	38	850
248	62,6	(101,0)	24,2	43,2	261	37	825
241	61,8	100,0	22,8	42,0	253	36	800
235	61,4	99,0	21,7	41,4	247	35	785
229	60,8	98,2	20,5	40,5	241	34	765
223	—	97,3	(18,8)	—	234	—	—
217	—	96,4	(17,5)	—	228	33	725
212	—	95,5	(16,0)	—	222	—	705
207	—	94,6	(15,2)	—	218	32	690
201	—	93,8	(13,8)	—	212	31	675
197	—	92,8	(12,7)	—	207	30	655
192	—	91,9	(11,5)	—	202	29	640
187	—	90,7	(10,0)	—	196	—	620
183	—	90,0	(9,0)	—	192	28	615
179	—	89,0	(8,0)	—	188	27	600
174	—	87,8	(6,4)	—	182	—	585
170	—	86,8	(5,4)	—	178	26	570
167	—	86,0	(4,4)	—	175	—	560
163	—	85,0	(3,3)	—	171	25	545
156	—	82,9	(0,9)	—	163	—	525
149	—	80,8	—	—	156	23	505
143	—	78,7	—	—	150	22	490
137	—	76,4	—	—	143	21	460
131	—	74,0	—	—	137	—	450
126	—	72,0	—	—	132	20	435
121	—	69,8	—	—	127	19	415
116	—	67,6	—	—	122	18	400
111	—	65,7	—	—	117	15	385

- 1) Figures within the () are not commonly used
- 2) Rockwell A, C and D scales utilises a diamond brale
- 3) 1 N/mm² = 1 MPa

■ Finished Surface Roughness

● Types of Surface Roughness Measurements

Types	Symbol	Method of Determination	Descriptive Figure
Maximum Height	* 1) Ry	This is the value (expressed in μm) measured from the deepest valley to the highest peak of the reference line, ℓ , extracted from the profile. (Disregard unusually high peaks and deep valleys as they are considered as flaws.)	
Ten-point Mean Roughness	* 2) Rz	From the profile, extract a portion to be the reference line, ℓ . Select the 5 highest peak and 5 deepest valleys. Measure the distance between the two lines and express it in μm . (1 μm = 0,001mm)	
Calculated Roughness	Ra	This method is to obtain a center line between the peaks and valleys within the reference line, ℓ . Fold along the center line to superimpose the valleys against the peaks. (Shaded portions with dashed outline on the right figure). Take the total shaded area and divided it by ℓ in μm .	

Designated values of the above types of surface roughness, standard reference length values and the triangular symbol classifications are shown on the table on the right.

- * 1) Ry : According to new JIS B 0601:2001 (Old symbol: Rz)
 * 2) Rz : According to new JIS B 0601:2001 (Old symbol: Rz_{JIS})

Designated values for * 1) Ry	Designated values for * 2) Rz	Designated values for Ra	Standard reference length values, ℓ (mm)	Triangular Symbols
(0,05S) 0,1S 0,2S 0,4S	(0,05Z) 0,1Z 0,2Z 0,4Z	(0,013a) 0,025a 0,05a 0,10a	—	
0,8S	0,8Z	0,20a	0,25	
1,6S 3,2S 6,3S	1,6Z 3,2Z 6,3Z	0,4a 0,8a 1,6a	0,8	
12,5S (18S) 25S	12,5Z (18Z) 25Z	3,2a 6,3a	2,5	
(35S) 50S (70S) 100S	(35Z) 50Z (70Z) 100Z	12,5a 25a	—	
(140S) 200S (280S) 400S (560S)	(140Z) 200Z (280Z) 400Z (560Z)	(50a) (100a)	—	—

Remarks: The designated values in the brackets do not apply unless otherwise stated.

Spare Parts

P1–P8

P

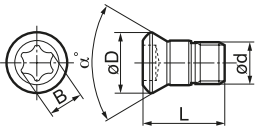


Screw	P2-P4
Lever Pin, Shim, Nut.....	P4-P6
Shim Pin, Eccentric Pin	P7
Wrench	P8

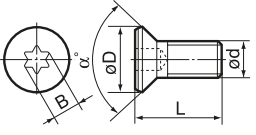
SPARE PARTS

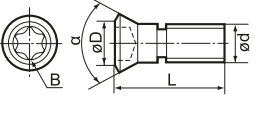
Screw

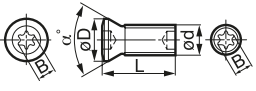
Screw

High Precision Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTG0408F	●	M4	0,5	7,5	5,7	T15	61	3,4	
	BTTG0409F	●	M4	0,5	8,4	6,15	T15	61	3,4	
	BFTG0513F	●	M5	0,5	13	6,8	T20	61	5,0	
	BFTG0617F	●	M6	0,75	16,5	8	T25	61	7,5	
	BFTG0621F	○	M6	0,75	21	9,5	T25	61	7,5	
	BFTG0825F	●	M8	0,75	24,5	12	T25	61	7,5	

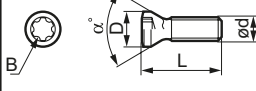
Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX02506		M							
	BFTX02508	●	M2,5	0,45	7,5	3,45	T8	60	-	
	BFTX0309		M3	0,5	8,8	4,2	T10	60	-	
	BFTX03508	●	M3,5	0,6	8	5,1	T10	52	2,0	
	BFTX03584	●	M3,5	0,6	7,4	5,2	T15	60	3,0	
	BFTX03588	●	M3,5	0,6	8,8	5,2	T15	60	3,4	
	BFTX0408	●	M4	0,7	8	5,5	T15	60	-	
	BFTX0414	●	M4	0,7	14,5	5,5	T15	60	3,0	
	BFTX0515		M5	0,8	15	7	T20	60	-	
	BFTX0613		M6	1,0	13	9	T25	60	-	
	BFTX0615		M6	1,0	15	9	T25	60	-	
	BFTX0617		M6	1,0	17	9	T25	60	-	

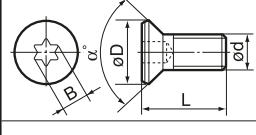
Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX0203A	●	M2	0,4	3	2,7	T6	90	0,5	
	BFTX0204A	●	M2	0,4	4,3	2,7	T6	90	0,5	
	BFTX0305A	●	M3	0,5	5,3	4,3	T10	90	-	
	BFTX0306A	●	M3	0,5	5,8	4,3	T10	90	2,0	
	BFTX0307A	●	M3	0,5	6,8	4,3	T10	90	2,0	
	BFTX0407A	●	M4	0,7	7,3	5,6	T15	90	3,4	
	BFTX0410A	●	M4	0,7	10,3	5,6	T15	90	3,4	
	BFTX0509A	●	M5	0,8	9,3	6,9	T20	90	5,0	

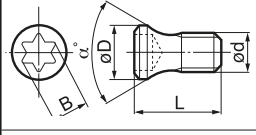
Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX01604N	●	M1,6	0,35	4,2	2,4	T6	60	0,2	
	BFTX0203N	●	M2	0,4	3	2,7	T6	60	0,5	
	BFTX0204N	●	M2	0,4	4,3	2,7	T6	60	0,5	
	BFTX02205N	●	M2,5	0,45	4,5	3	T6	60	0,5	
	BFTX02505N	●	M2,5	0,45	4,5	3,45	T8	60	1,1	
	BFTX02506N	●	M2,5	0,45	5,5	3,45	T8	60	1,5	
	BFTX02508NV	●	M2,5	0,45	7,5	3,5	T8	60	1,5	
	BFTX0306N	□	M3	0,5	5,8	4,2	T10	60	2,0	
	BFTX0307N	●	M3	0,5	6,5	4,2	T10	60	2,0	
	BFTX0309N	●	M3	0,5	9	4,2	T10	60	3,0	
	BFTX0312N		M3	0,5	12	5,4	T10	60	-	
	BFTX03509N	●	M3,5	0,6	8,5	4,9	T10	60	-	
	BFTX0406N	●	M4	0,7	6	5,6	T15	60	-	
	BFTX0407N	●	M4	0,7	7	5,6	T15	60	3,0	
	BFTX0409N	●	M4	0,7	9	5,6	T15	60	3,4	
	BFTX0412N	●	M4	0,7	12	5,5	T15	60	3,0	
	BFTX0509N	●	M5	0,8	9	7	T20	60	5,0	
	BFTX0511N	●	M5	0,8	11,5	7	T20	60	5,0	
	BFTX0513N	●	M5	0,8	13	7	T20	60	5,0	
	BFTX0515N	●	M5	0,8	15	7	T20	60	-	
	BFTX0615N	●	M6	1,0	15	9	T25	60	5,0	
	BFTX0619N	●	M6	1,0	19	9	T25	60	5,0	

Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX0410T8L	●	M4	0,7	9,6	5,6	T8	60	1,1	
	BFTX0410T8R	●	M4	0,7	9,6	5,6	T8	60	1,1	

Screw

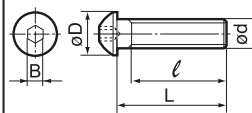
Torx Plus Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX01804IP	●	M1,8	0,35	3,7	2,45	6IP	60	0,5	
	BFTX02505IP	●	M2,5	0,45	4,5	3,45	8IP	60	-	
	BFTX02506IP	●	M2,5	0,45	5,5	3,45	8IP	60	-	
	BFTX0305IP	●	M3	0,5	5,3	3,8	8IP	60	2,0	
	BFTX0306IP	●	M3	0,5	6	3,8	8IP	60	2,0	
	BFTX0307IP		M3	0,5	7	4,3	10IP	55	2,0	
	BFTX0308IP	○	M3	0,5	8	3,8	8IP	60	-	
	BFTX03510IP	○	M3,5	0,6	11,5	5,3	15IP	60	3,0	
	BFTX03584IP	●	M3,5	0,6	7,4	5,1	15IP	60	-	
	BFTX03510IP08	●	M3,5	0,6	10	5,3	8IP	60	-	
	BFTX03510IP15	●	M3,5	0,6	10	5,3	15IP	60	-	
	BFTX0407IP	●	M4	0,7	8,0	5,6	15IP	60	3,0	
	BFTX0409IP	●	M4	0,7	9,0	5,6	15IP	60	3,0	
	BFTX0412IP	●	M4	0,7	12	5,5	15IP	60	3,0	
	BFTX0418IP	●	M4	0,7	18	5,5	15IP	60	-	
	BFTX04513IP20	●	M4,5	0,75	13,1	6,8	20IP	60	-	
	BFTX0511IP	●	M5	0,8	11,5	7	20IP	60	-	
	BFTX0513IP	●	M5	0,8	13	7	20IP	60	-	
	BFTX0615IP	●	M6	1,0	15	9	25IP	60	-	

Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTX03510SD		M3,5	0,6	10	5,3	T10	60	2,0	
	BFTX03517SD		M3,5	0,6	17	5,3	T10	60	2,0	
	BFTX0618SD	□	M5	0,8	17	7,2	T20	60	5,0	
	BFTX0618SD		M6	1,0	18		T25	60	7,5	

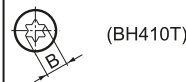
Torx Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						α°	Nm
			d	Pitch	L	D	B	α°		
	BFTY02205	●	M2,2	0,45	5,0	3,05	T7	60	-	
	BFTY02206	●	M2,2	0,45	5,6	3,05	T7	60	1,0	

Button Head Cap Screw	Cat. No.	Stock	Dimensions (mm)						Nm
			d	Pitch	L	ℓ	D	B	
	BH0304		M3	0,5	4	Full	5,5	2	-
	BH0306	●	M3	0,5	6	Full	5,5	2	-
	BH0308 (FBUP3-A0-9)	●	M3	0,5	8	Full	5,5	2	1,0
	BH0310	●	M3	0,5	10	Full	5,5	2	-
	BH03504		M3,5	0,6	4	Full	7	2	-
	BH0408		M4	0,7	8	Full	6	2,5	-
	BH0415	○	M4	0,7	15	Full	7,5	2,5	-
	BH0510		M5	0,8	10	Full	9,5	3	-
	BH0516	●	M5	0,8	16	14,4	9,5	3	-
	BH0616	●	M6	1,0	16	14	10,5	4	-
	BH0620	●	M6	1,0	20	Full	10,5	4	-
	BH0824R		M8	1,25	24	20	12	4	-
	BH0824L		M8	1,25	24	20	12	4	-
	BH0825	○	M8	1,25	25	22,5	14	5	-
	BH0830R		M8	1,25	30	26	12	4	-
	BH0830L		M8	1,25	30	26	12	4	-
	BH0832		M8	1,25	32	29,5	14	5	-
	BH1030R		M10	1,5	30	26	14	5	-
	BH1030L		M10	1,5	30	26	14	5	-
	BH1036R		M10	1,5	36	32	14	5	-
	BH1036L		M10	1,5	36	32	14	5	-

Hexagonal Hole Type



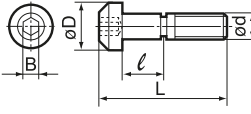
T Type with Torx Hole

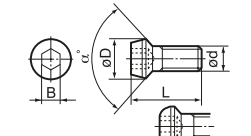


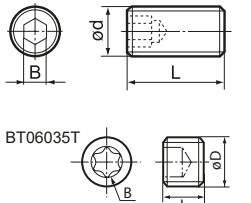
SPARE PARTS

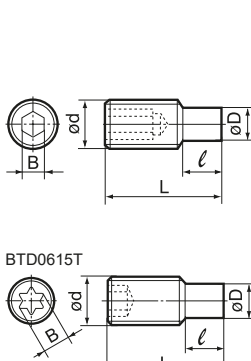
Screw

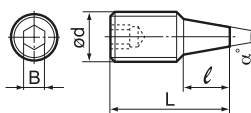
■ Screw

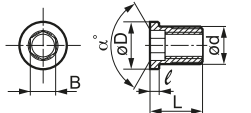
Phillip Head Cap Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	BHA0525	●	M5	0,8	25,5	9,5	8,5	3	4,0
	BHA0625	●	M6	1,0	30	11,3	10,5	4	4,5
	BHA0834		M8	1,25	34,2	12,7	12,0	5	-
	BHE0407		M4	0,7	9,5	2	5,7	2,5	1,8
	BHE0510	○	M5	0,8	13	3	7,7	3	2,7

Button Head Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	D	B	α°	
	BHF0203L		M2	0,4	4	3	1,5	90	
	BHF0203B		M2	0,4	5,5	3,5	1,5	90	
	BHF0306R		M3	0,5	6,3	4,2	2	90	1,0
	BHF0308R		M3	0,5	8	4,2	2	90	1,0
	BHF0623	○	M6	1,0	23	12	4	90	7,0

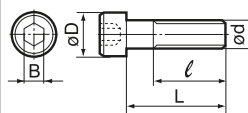
Set Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	D	B	α°	
	BT0306		M3	0,5	6	-	1,5	-	-
	BT0310		M3	0,5	10	-	1,5	-	-
	BT0404	●	M4	0,7	4	-	2	-	-
	BT0506	●	M5	0,8	6	-	2,5	-	-
	BT0510		M5	0,8	10	-	2,5	-	-
	BT0610		M6	1,0	10	-	3	-	-
	BT0612		M6	1,0	12	-	3	-	-
	BT0620		M6	1,0	20	-	3	-	-
	BT06035T		M6	1,0	3,5	-	T15	-	-

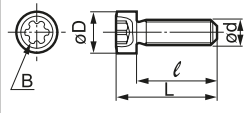
Set Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	BTD0408		M4	0,7	8	2	2,8	2	-
	BTD0410		M4	0,7	10	2	2,8	2	-
	BTD0412		M4	0,7	12	2	2,8	2	-
	BTD0508		M5	0,8	8	3	3,5	2,5	-
	BTD05F09		M5	0,5	9	2	4	T15	-
	BTD0510	□	M5	0,8	10	3	3,5	2,5	3,0
	BTD0518		M5	0,8	18	4	3,5	2,5	-
	BTD0609	○	M6	1,0	9	2	4	3	-
	BTD0615		M6	1,0	15	5	4	3	-
	BTD0618		M6	1,0	18	5	4	3	-
	BTD0620		M6	1,0	20	5	4	3	-
	BTD0812		M8	1,25	12	2	5	4	-
	BTD0818		M8	1,25	18	6	5	4	-
	BTD0820		M8	1,25	20	6	5	4	-
	BTD0825		M8	1,25	25	8,5	5	4	-
BTD0615T		M6	1,0	15	5	4,3	T20	-	

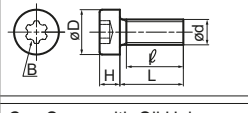
Set Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	B	α°	
	BTT0407	●	M4	0,5	7	2,6	2	60	-
	BTT0411	●	M4	0,5	11	2,6	2	60	-
	BTT0511		M5	0,8	11	5	2	20	-
	BTT0615		M6	1,0	15	6	2,5	20	-

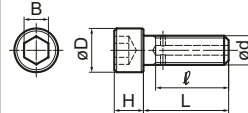
Special Hollow Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	BW0507F	●	M5	0,5	7	1,2	6,3	3,5	-
	BW0609F		M6	0,75	9	1,5	7,7	4	-
	BW0508F-SD		M5	0,5	8	1,2	6,3	3,5	-
	BW0810F-SD	□	M8	0,75	10	1,8	10	5	-
	BW0912F-SD		M9	0,75	12				-

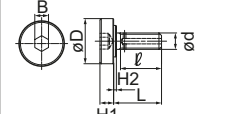
■ Screw

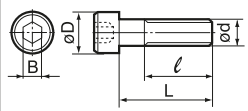
Cap Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	BX0304		M3	0,5	4	Full	5,5	2,5	-
	BX0308		M3	0,5	8	Full	5,5	2,5	-
	BX0315		M3	0,5	15	Full	5,5	2,5	-
	BX0320		M3	0,5	20	Full	5,5	2,5	-
	BX0408		M4	0,7	8	Full	7	3	-
	BX0410		M4	0,7	10	Full	7	3	-
	BX0414	●	M4	0,7	14	Full	7	3	-
	BX0425		M4	0,7	25	20	7	3	-
	BX0508	○	M5	0,8	8	Full	8,5	4	-
	BX0510	○	M5	0,8	10	Full	8,5	4	-
	BX0512	●	M5	0,8	12	Full	8,5	4	-
	BX0515	●	M5	0,8	15	Full	8,5	4	-
	BX0520	●	M5	0,8	20	Full	8,5	4	5,0
	BX0520T	●	M5	0,8	20	16	8,5	T20	-
	BX0615	○	M6	1,0	15	Full	10	5	-
	BX0620	○	M6	1,0	20	Full	10	5	-
	BX0622	●	M6	1,0	22	18	10	5	-
	BX0625		M6	1,0	25	18	10	5	-
	BX0820		M8	1,25	20	Full	13	6	-

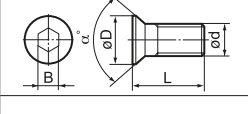
Cap Screw (Torx Plus)	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	BXD02208IP	●	M2,2	0,45	7,5	5,7	3,5	8IP	-
	BXD02509IP	●	M2,5	0,45	9	7	4,1	10IP	-
	BXD03011IP	●	M3	0,5	10,5	8	4,9	15IP	-
	BXD03512IP	●	M3,5	0,6	11,5	8,8	5,5	15IP	-
	BXD04014IP	●	M4	0,7	12,5	9,5	6	20IP	-
	BXD04515IP	●	M4,5	0,75	14,3	10,8	6,8	25IP	-

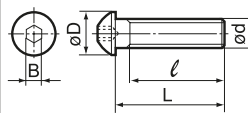
Cap Screw (Torx Plus)	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	H	
	BXA0310IP	○	M3	0,5	7,5	Full	5,3	2,4	10IP
									2,0

Cap Screw with Oil Hole	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	H	
	BXH0825-D13	○	M8	1,25	25	Full	13	8	6
	BXH1030-D16	○	M10	1,5	30	Full	16	10	8
	BXH1235-D18	○	M12	1,75	35	Full	18	12	10

Cap Screw with Oil Hole	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	H1	
	BXH1235-D33	○	M12	1,75	35	Full	33	10	2
	BXH1635-D40	○	M16	2,0	35	30	40	10	-
	BXH2036-D50	○	M20	2,5	36	29	50	14	4

Cap Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	EHBX0512	○	M5	0,8	12	10,5	8	4	-

Flat Head Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	B	α°	
	FBUP2-A0-8	□	M3	0,5	10	5,5	2	82	1,0
	FBUP3-A0-8		M3,5	0,6	12	7	2	82	1,0
	FBUP4-A0-8		M5	0,8	15	9,3	3	82	2,7

Button Head Cap Screw	Cat. No.	Stock	Dimensions (mm)						
			d	Pitch	L	ℓ	D	B	
	FBUP3-A0-9	●	M3	0,5	8	Full	5,5	2	1,0

SPARE PARTS

Screw, Lever Pin

■ Screw

Axial adjustment Screw	Cat. No.	Stock	Dimensions (mm)						Nm
			d	Pitch	L	ℓ	D	B	
	FMJ	●	M4	0,5	15	5	6	3	-
	FMUJ	●	M4	0,7	17	10,5	6	1	-
	RFJ	●	M4	0,7	12	6	6	2	-
	SRFJ	●	M4	0,7	17	10,5	6	2	-
	KGBS1111	●	M5	0,5	8	1,2	6	3,5	-
	KGBS1221	□	M6	0,75	9	1,5	7,5	4,5	-
	KSS1111	●	3,5	0,6	11	5,2	T15	55	3,5
	KSS1221	□	4,5	0,75	12	6,6	T15,3	55	4,5
	LCS2B	●	M3	0,5	10	3,05	3,6	2	-
	LCS3	●	M6	1,0	17	10	6	2,5	-
	LCS3B-SD	●	M5	0,8	9,5	4,2	5	2	-
	LCS3DB-SD	●	M5	0,8	12	6	5	2	-
	LCS3S	●	M6	1,0	15	10	6	2,5	-
	LCS3TB-SD	●	M6	1,0	16,7	9,6	6	2,5	-
	LCS3TE	●	M6	1,0	15,5	8,5	6	2,5	-
	LCS4	●	M8	1,0	21	10	8	3	-
	LCS4B-SD	●	M6	1,0	13,4	9	6	2,5	-
	LCS41BS-SD	●	M8	1,0	17	9,3	8	3	-
	LCS42BS-SD	●	M8	1,0	20,7	9,8	8	3	-
	LCS4CA	●	M8	1,0	17,5	10	8	3	-
	LCS5	●	M8	1,0	25	12	8	3	-
	LCS5B-SD	□	M8	1,0	20,5	12,3	8	3	-
	LCS5DB-SD	□	M8	1,0	21,1	11,4	8	3	-
	LCS6	○	M10	1,0	27,2	14,4	9,8	4	-
	LCS6B-SD	●	M10	1,0	27,2	14,4	10	4	-
	LCS10	●	M5	0,8	14,5	8,5	5	2	-
	LCS12	●	M6	1,0	17	9,6	6	2,5	-
	LCS16	○	M6	1,0	21	13,6	6	2,5	-
	LCS20	●	M8	1,0	23,5	13,2	8	3	-
	LCS25	●	M10	1,0	30	17,4	10	4	-
	LCS32	●	M12	1,0	36	19,3	12	5	-
	MIB1.6-2	□	M1,6	0,35	2,0	-	2,4	-	0,2
	MIB1.6-2.5	●	M1,6	0,35	2,5	-	2,4	-	0,2
	MIB1.6-3	●	M1,6	0,35	3,0	-	2,4	-	0,2

■ Double Screw

Double Screw	Cat. No.	Stock	Dimensions (mm)						Nm
			d	Pitch	L	ℓ	D	B	
	WB4-8	●	M4	0,7	7,5	3	3,0	2	-
	WB5-10	●	M5	0,8	10	4	3,8	2,5	-
	WB5-12	○	M5	0,8	12	5	3,8	2,5	-
	WB6-13	○	M6	1,0	13	5	4,5	3	-
	WB6-16	●	M6	1,0	16	6	4,5	3	-
	WB6-20	□	M6	1,0	20	8,5	4,5	3	-
	WB6-30	●	M6	1,0	30	12	4,5	3	-
	WB8-20	●	M8	1,25	20	8,5	6,2	4	-
	WB8-24	●	M8	1,25	24	8,5	6,2	4	-
	WB8-30	●	M8	1,25	30	11,5	6,2	4	-
	WB8F-30	□	M8	1,0	30	11,5	6,2	4	-
	WB6-16T	□	M6	1,0	16	6	4,5	T20	-
	WB6-20T	○	M6	1,0	20	8,5	4,5	T20	-
	WB6-20TL	○	M6	1,0	20	8,5	4,5	T20	-
	WB7-15T	●	M7	1,0	15	5,5	5	T25	-
	WB7F-15T	○	M7	0,75	15	8,5	5,5	T25	-
	WB7F-20TL	○	M7	0,75	20	8,5	5,5	T25	-
	WB8-22T	●	M8	1,25	22	8,5	6,2	T27	-
	WB8-22TL	●	M8	1,25	22	8,5	6,2	T27	-
	WB8-30T	●	M8	1,25	30	11,5	6,2	T27	-
	WB8-30TL	●	M8	1,25	30	11,5	6,2	T27	-
	WB8R-16T	○	M8	1,25	14	5,5	6,2	T27	-
	LCL3	●	3,7	12	10	3,6			
	LCL3-SD	●	3,7	12	10	3,55			
	LCL3C-SD	□	3,1	7,8	9,9	3,1			
	LCL3D-SD	●	3,7	11,5	12	3,55			
	LCL3DB-SD	●	3,1	9,4	11,5	3,1			
	LCL3S	●	3,7	10,6	10	3,6			
	LCL3T-SD	□	2,6	6,3	7,2	2,15			
	LCL4	●	4,7	14	14,55	4,7			
	LCL4-SD	●	4,65	13,2	13,35	4,7			
	LCL4C-SD	●	4,65	10	13,35	4,7			
	LCL4D-SD	●	4,65	14,8	16	4,7			
	LCL4T-SD	●	4,65	13,2	13,35	4,7			
	LCL5	●	6	17	17,1	6			
	LCL5-SD	●	6	17,3	16,65	6			
	LCL5C-SD	□	7,5	18,1	20,5	7,5			
	LCL6-SD	●	7,5	21	20,5	7,5			
	LCL8	●	8,6	25,4	25,4	8,6			
	LCL06	●	2,5	6,28	7,0	2			
	LCL09	●	3,5	9,3	10,75	3			
	LCL10	●	3,4	11,8	10,8	3			
	LCL12	●	3,7	13,4	12,9	3,5			
	LCL16	○	4,6	17,6	18,4	4,4			
	LCL20	□	6	18,9	20,4	5,6			
	LCL32	□	8,5	26,8	29,8	8			

■ Lever Pin

SPARE PARTS Shim

■ Shim

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	
CCS09T3	●	8,525	2,38	5,4	6,4	

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	
CNS1204	●	12,57	4,76	4,4	6,0	
CNS1606	○	15,75	4,76	5,5	7,5	
CNS1906	●	18,70	6,35	5,5	7,5	
CNS2509	□	25,27	6,35	6,6	9,5	
CNS1203B	●	12,57	3,18	3,4	4,5	
CNS1204B	●	12,57	4,76	4,4	6,0	

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
DCS11T3	●	8,5	2,38	5,3	6,4

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	θ°
DGCS13R	●	13,7	3,9	6,8	8,8	5

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	
DNS1504	●	12,57	6,35	4,4	6,0	
DNS1506	●	12,57	4,76	4,4	6,0	
DNS1104B	○	9,45	4,73	3,4	4,5	
DNS1504B	○	12,57	6,35	4,4	6,0	
DNS1506B	○	12,57	4,76	4,4	6,0	

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
HE060011E	●				

Cat. No.	Stock	Dimensions (mm)		
		A	T	d
LST317SD	●	9,5	2,7	5,2
LST42SD	●	12,65	3,18	6,9

Cat. No.	Stock	Dimensions (mm)		
		A	T	d
LSS32SD	●	9,48	3,18	5
LSS42SD	●	12,65	3,18	6,9
LSS53SD	□	15,85	4,76	7,9
LSS63SD	●	19	4,76	10

Cat. No.	Stock	Dimensions (mm)		
		A	T	d
LSC32SD	●	9,48	3,18	5
LSC42SD	●	12,65	3,18	6,9
LSC53SD	●	15,85	4,76	7,9
LSC63SD	□	19	4,76	10

Cat. No.	Stock	Dimensions (mm)		
		A	T	d
LSD32SD	●	8,5	3,18	5
LSD42SD	●	12,65	3,18	6,9

■ Shim

Cat. No.	Stock	Dimensions (mm)			
		A	T	d	
LSR817	□	8,4	2,7	5,2	
LSR10	●	8,4	3,18	4,7	
LSR12	●	10	3,18	4,7	
LSR16	●	13,5	4,76	6,3	
LSR20	●	17,2	4,76	7,9	
LSR25	●	22	6,35	9,5	

Cat. No.	Stock	Dimensions (mm)			
		A	T ₁	T ₂	d ₂
LSTE31-0	●	9,5	2,7	2,7	5,2
LSTE31-1	●	9,5	2,67	2,91	5,2
LSTE31-2	●	9,5	2,64	3,11	5,2

Cat. No.	Stock	Dimensions (mm)			
		A	T	d	θ°
SCND433	□	12,65	4,76	3,4	80
SCN0903	□	9,5	3,18	3,4	

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
SCS1204	□	11,5	3,18	6,4	7,9

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	
SNS1204	●	12,57	4,76	4,4	6,0	
SNS1506	○	15,75	4,76	5,5	7,5	
SNS1906	●	18,92	6,35	5,5	7,5	
SNS2507	○	25,27	7,93	6,6	9,5	
SNS2509	●	25,27	6,35	6,6	9,5	

Cat. No.	Stock	Dimensions (mm)				
		A	T	d ₁	d ₂	θ°
SVW322		9,5	3,18	4,7	6,5	35
SFW433		12,65	4,76	6,2	8,0	50
SDW323	●	9,5	3,18	4,7	6,5	55
SDW423	●	12,65	3,18	6,2	8,0	55
SDW433	○	12,65	3,18	6,2	8,0	80
SCW423	●	12,65	3,18	6,2	8,0	80
SCW433	○	19	4,76	9	11,5	80
SCW635	○	19	4,76	9	11,5	80

Cat. No.	Stock	Dimensions (mm)			
		D			
SRND32Z	○	9,5			
SRND42	○	12,7			

Cat. No.	Stock	Dimensions (mm)		
		A	T	d
SSND423	○	12,5	3,18	3,4
SSN0903	□			

SPARE PARTS

Shim, Nut

Shim

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
SSW423	□	12,65	3,18	6,2	8
SSW433	○	12,65	4,76	6,2	8
SSW635	○	19	4,76	9	11,5

Cat. No.	Stock	Dimensions (mm)				θ°
		A	T	d		
STPD322	●	8,4	3,18	3,4		6
STPD422	○	11,0	3,18	3,4		6

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
STW323	●	9,5	3,18	4,7	6,5
STW434	●	12,65	4,76	6,2	8
STW333	○				

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
SWW433	●	12,65	5,15	6,2	8
LSW317	●				

Cat. No.	Stock	Dimensions (mm)				θ°
		A	T	d ₁	d ₂	
TCS16T3	□	8,8	2,38	5,3	6,3	7

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
TNS1604	●	9,45	4,76	3,4	4,5
TNS1603B	○	9,45	3,18	3,4	4,5
TNS1604B	○	9,45	4,76	3,4	4,5

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
TRW5505	●	10,5	4,76	3,4	4,5

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
VCS1604	●	8,25	3,18	5,3	6,4

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
VNS1604	●	9,45	4,76	3,4	4,5

Shim

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
WFXS4R	●	10,17	3,0	5,5	7,5

Cat. No.	Stock	Dimensions (mm)				θ°
		A	T	d ₁	d ₂	
WGCS13R	●	10,7	3,0	5,5	7,5	5

Cat. No.	Stock	Dimensions (mm)			
		A	T	d ₁	d ₂
WNS0604	●	9,52	3,18	3,5	4,5
WNS0804	●	12,57	4,76	4,4	6,3
WNS0603B	□	9,27	3,18	3,4	4,5
WNS0803B	○	12,57	3,18	3,4	4,5
WNS0804B	○	12,57	4,76	4,4	6,0

Seat

Cat. No.	Stock	Dimensions (mm)		
		d	L	H
PWSS4R	▲	4,6	15	8

Ring

Cat. No.	Stock	Dimensions (mm)			
		A	B	T	d
ER03	○	7	2,6	0,6	3
ER04	●	9	3,5	0,6	4
ER05	●	11	4,3	0,6	5

Nut

Cat. No.	Stock	Dimensions (mm)			
		L			
BNBW-2	●	3			
BNBW-4	○	4			
BNBW-7	□	7			

Cat. No.	Stock	Dimensions (mm)			
		d	L	D	B
CPM32N	●	M4	7,5	7	3
CPM43N	●	M5	8,5	7	3
CPM43S	○	M5	6	7	3

Cat. No.	Stock	Dimensions (mm)				
		d	Pitch	L	D	B
CPV33N	●	M4	0,5	6,0	6,0	2,5

SPARE PARTS

Shim Pin, Eccentric Pin

Shim Pin

Cat. No.	Stock	Dimensions (mm)						
		d	Pitch	L	D	d ₁	B	
HE060011P	●	M6	0,75	14,5	7,8	5,0	2,5	

Cat. No.	Stock	Dimensions (mm)		
		d	D	L
LP04	●	0,4	1,1	4,7
LP06	●	0,4	1,1	6,0
LP07	●	0,4	1,1	7,7

Cat. No.	Stock	Dimensions (mm)		
		d	H	L
LSP3		5	3,5	5,5
LSP3SD	●	5	3,5	5,5
LSP4		6,7	4	7
LSP4SD	●	6,7	4	7
LSP5SD	●	7,7	4,5	8,5
LSP6SD	●	9,85	5,9	11,1
LSP8		13,05	10	12
LSP10	●	5	3,3	6,5
LSP16	○	6,6	4,5	9
LSP20	●	8,2	5,5	9
LSP25		9,8	6,5	11
LSP32		13	10	12

Cat. No.	Stock	Dimensions (mm)						
		d	Pitch	L	D	D ₁	d ₁	
MP317		M4	0,7	15,5	6	4	3,7	
MP320	●	M4	0,7	19,5	6	4	3,7	
MP416	●	M5	0,8	14	7,5	6	5	
MP420	●	M5	0,8	20	7,5	6	5	
MP432	○	M5	0,8	32	7,5	6	5	
MP531								
MP534								

Cat. No.	Stock	Dimensions (mm)				
		d	L	D	θ°	
SPP308	○	3,2	8	4,8	120	

Cat. No.	Stock	Dimensions (mm)		
		L	D	
SPP3	○	14	3,2	

Cat. No.	Stock	Dimensions (mm)					
		d ₁	d ₂	L	D	ℓ ₁	ℓ ₂
VP20	●	M3,5	M4	12,0	5,0	≥4,5	≥4,5
VP25	●	M3,5	M4	17,0	5,0	≥4,5	≥4,5
VP32	●	M3,5	M4	24,0	5,0	≥4,5	≥4,5

Cat. No.	Stock	Dimensions (mm)					
		d	Pitch	L	ℓ	D ₁	D ₂
VP32B	●	M3,5	0,6	8,0	1,4	5,0	6,5
VP40B	●	M3,5	0,6	11,5	1,4	5,0	6,5

Eccentric Pin

Cat. No.	Stock	Dimensions (mm)					
		d	D ₁	D ₂	L	ℓ	B
CPB34	●	3,4	4,1	5,5	14	5	2,5
CPB35	○	3,4	4,1	5,5	17	5	2,5
CPB42	●	4,5	5,5	7	14	5	3
CPB43	●	4,5	5,5	7	19	5	3
CPB43S	●	4,5	5,5	7	16	5	3
CPB44T	□	4,5	5,5	7	22	5	3
CPB45T	○	4,5	5,5	7	27	5	3
CPB64	○	6,8	8,2	10,5	24	6,6	4

Cat. No.	Stock	Dimensions (mm)					
		d	D ₁	D ₂	L	ℓ	B
CPU304C	○	3,3	5,5	-	10	3,5	3

Wrench

Cat. No.	Stock	Dimensions (mm)				
		B	d	C	b ₁	b ₂
TRXW10IP	○	10IP	2,6	40	75	40

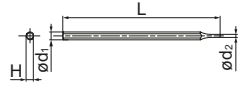
Cat. No.	Stock	Dimensions (mm)				
		B	d	ℓ	ℓ ₁	ℓ ₂
TRB10IP	○	10IP	4			
TRB15IP	○	15IP	4			
TRB20IP	○	20IP	4,55			
TRB25IP	○	25IP				


Cat. No.	Stock	Dimensions (mm)			Remarks
		D	L		
HPS1015	○	32	99,4	For 10IP, 15IP	
HPL2025	○	35,5	110,3	For 20IP, 25IP	

SPARE PARTS

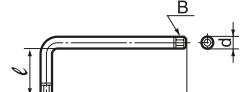
Wrench

Wrench

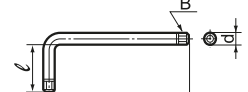
Socket Wrench	Cat. No.	Stock	Dimensions (mm)			
			d ₁	d ₂	L	H
	ANT	○	5	2	100	4,5

Hex Wrench (Hexagonal)	Cat. No.	Stock	Dimensions (mm)			
			B	L	ℓ	
	LH020	●	2	50	16	
	LH025	●	2,5	56	18	
	LH030	●	3	63	20	
	LH035	●	3,5	68	22	
	LH040	●	4	70	25	
	LH050	○	5	80	28	
	LH060	○	6	90	32	

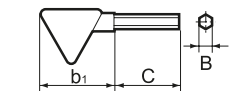
	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	
	LH035K	●				
	LH045K	□				

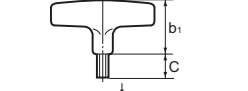
Torx Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	d	L	ℓ
	LT0806	●	T8	2,3	45,0	6,0
	LT20	○	T20	3,9	57,2	19,1
	LT25	□	T25	4,4	60,3	20,2
	LT27	●	T27	4,96	63,5	21,5
	LT1510	○	T15	3,26	62	10

	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	
	LT15K	●				

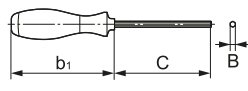
Torx Plus Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	d	L	ℓ
	LT20IP		T20	4,0	57	18,5
	LT25IP		T25	4,5	60	19,5

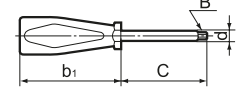
	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	
	SDBSM	●				

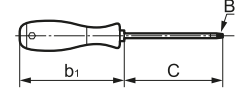
Hex Wrench (Hexagonal)	Cat. No.	Stock	Dimensions (mm)		
			B	b ₁	C
	TH015	○	1,5	35	30
	TH020	●	2	35	39
	TH025	○	2,5	35	39

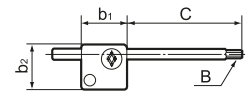
Hex Wrench (Hexagonal)	Cat. No.	Stock	Dimensions (mm)		
			B	b ₁	C
	TH030	●	3	48	28
	TH040	●	4	48	37
	TH050	○	5	48	45

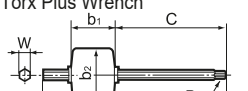
Wrench

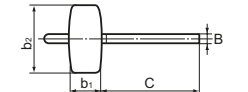
Hex Wrench (Hexagonal)	Cat. No.	Stock	Dimensions (mm)		
			B	C	b ₁
	HD040	○	4	75	111

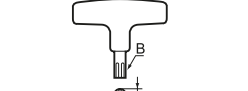
Torx Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	d	C	B ₁
	TRD07	●	T7	2,0	45	70
	TRD08	●	T8	2,3	55	70
	TRD15	○	T15	3,3	70	100
	TRD20	●	T20	3,9	100	90
	TRD25	●	T25	5,3	80	110

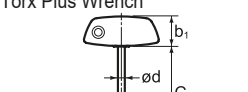
Torx Plus Wrench	Cat. No.	Stock	Dimensions (mm)		
			B	C	b ₁
	TRDR06IP05	●			
	TRDR08IP	●	8IP	60	104
	TRDR10IP	●	10IP	80	111
	TRDR15IP	●	15IP	80	111
	TRDR20IP	●	20IP	100	118
	TRDR25IP	●	25IP	100	118

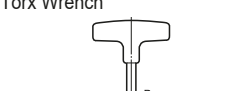
Torx Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	b ₂
	TRX06	●	T6	35,5	15	15
	TRX08	●	T8	38,5	19	19
	TRX10	●	T10	42,1	22	22
	TRX15	●	T15	46	22	27
	TRX20	●	T20	49	22	30

Torx Plus Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	b ₂
	TRX06IP	●	6IP	34	15	15

Hex Wrench (Hexagonal)	Cat. No.	Stock	Dimensions (mm)			
			B	C	b ₁	b ₂
	TSW040	○	4	60	20	40

Torx Wrench	Cat. No.	Stock	Dimensions (mm)		
			B	d	
	TT25	●	T25	4,4	
	TT27	●	T27	5,0	

Torx Plus Wrench	Cat. No.	Stock	Dimensions (mm)			
			B	d	C	b ₁
	TTR15IP	●	15IP	4,0	80	25,5

Torx Wrench	Cat. No.	Stock	Dimensions (mm)		
			B	d	
	TTX15W	●	T15	4,0	
	TTX20	●	T20	3,9	

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AFBSM**	M38, M39	Spare parts
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ANB****R-G	G64, H61, M50	SUMIDIA blades
ANB****R-H	G64, H61, M50	SUMIDIA blades
ANB****R-L	G64, H61, M50	SUMIDIA blades
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AOMT****PEER-L	G39, G47, H21, H29, H31	Indexable insert
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AOMT**T3**PEER-H	G39, G47, H21, H25, H27	Indexable insert
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AXMT****PEER-E	G48, G49, H35, H36, H45, H51	Indexable insert
AXMT****PEER-EH	G48, G49, H35, H36, H45, H51	Indexable insert
AXMT****PEER-G	G48, G49, H35, H36, H45, H51	Indexable insert
AXMT****PEER-H	G48, G49, H35, H36, H45, H51	Indexable insert
AXMT****PEER-L	G48, G49, H36, H51	Indexable insert

B		
B***-SCLC R/L ****-**	E14	Boring bar
B***-SDQC R/L ****-**	E17	Boring bar
B***-SDUC R/L ****-**	E16	Boring bar
B***-STUP R/L ****-**	E20	Boring bar
BCS**	F46, F47	Spare parts
BFTG****F	P2	Spare parts
BFTX****	P2	Spare parts
BFTX****	P2	Spare parts
BFTX****A	P2	Spare parts
BFTX****IP	P2	Spare parts
BFTX****IP	P2	Spare parts

BFTX****IP**	P2	Spare parts
BFTX****N	P2	Spare parts
BFTX****N	P2	Spare parts
BFTX****NV	P2	Spare parts
BFTX****SD	P2	Spare parts
BFTX****SD	P2	Spare parts
BFTX****T8 R/L	P2	Spare parts
BFTY****	P2	Spare parts
BH****	P2	Spare parts
BH****	P2	Spare parts
BH**** R/L	P2	Spare parts
BHA****	P3	Spare parts
BHF****	P3	Spare parts
BNB*** R/L	M41	Boring bar
BNBB**R	M40	Boring bar
BNBC	M41	Spare parts
BNBP 2R*** ** *	J41, M57	SUMIBORON endmill
BNBW* [*]	P6	Spare parts
BNES****	J40, M56	SUMIBORON endmill
BNGC R/L	M44	Spare parts
BNGG R/L ****-TT	M44	Tool holder
BNGS R/L TT	M44	Spare parts
BNTT**** R/L	M41	SUMIBORON insert
BNZ****R	M41	Boring bar
BSME R/L ****D*S6	M38	Boring bar
BT****	P3	Spare parts
BT****E	F22, F26	Spare parts
BT****T	P3	Spare parts
BTD****	P3	Spare parts
BTR****	D30	Indexable insert
BTT****	P3	Spare parts
BW****F	P3	Spare parts
BW****F-SD	P3	Spare parts
BWS**	F46, F48	Spare parts
BX****	P3	Spare parts
BX****T	P3	Spare parts
BXA****IP	P3	Spare parts
BXH****D**	P3	Spare parts
BXBR****R	E24	Boring bar
BXBR****R-NB	E24	Boring bar
BXD****IP	P3	Spare parts

C		
C***-SCLP R/L **	E15	Boring bar
C***-SSKP R/L **	E18	Boring bar
C***-STUB R/L **	E20	Boring bar
C***-STUP R/L **	E20	Boring bar
C***-SWUB R/L **	E23	Boring bar
CBC*	D25	Spare parts
CBC****	D25	Spare parts
CBD4 R/L	D25	Spare parts
CBS**	D25	Spare parts
CCET****LFY/RFY	C61	Indexable insert
CCET**T***LFY/RFY	C61	Indexable insert
CCET**X***LFY/RFY	C61	Indexable insert
CCET**X***LFY/RFY	C61	Indexable insert
CCGT**X***LFY/RFY	C63	Indexable insert
CCGT****LFX/RFX	C62	Indexable insert

CCGT*****LFX/RFX	C62	Indexable insert	CNGA*****LE-NC2	M9	SUMIBORON insert
CCGT**T***LFX/RFX	C62	Indexable insert	CNGA*****LF-NU2	M10	SUMIBORON insert
CCGT**T***LFX/RFX	C62	Indexable insert	CNGA*****LS-NC2	M9	SUMIBORON insert
CCGT**X***LFYS/RFYS	C62	Indexable insert	CNGA*****LT-NC2	M9	SUMIBORON insert
CCGT**X***LFYS/RFYS	C62	Indexable insert	CNGA*****NC-4	M9	SUMIBORON insert
CCGT*****M NFC	C62	Indexable insert	CNGA*****NC-W4	M9	SUMIBORON insert
CCGT*****M NSC	C63	Indexable insert	CNGA*****NC-WG4	M9	SUMIBORON insert
CCGT*****M NSI	C63	Indexable insert	CNGA*****NC-WH4	M9	SUMIBORON insert
CCGT*****NAG	C63	Indexable insert	CNGA*****NS-2	M10	SUMIBORON insert
CCGT*****NFV NC2	M4	SUMIBORON insert	CNGA*****NU-2	M10	SUMIBORON insert
CCGT*****NFV NU2	M6	SUMIBORON insert	CNGA*****NU-W2	M10	SUMIBORON insert
CCGT*****NLV NC2	M4	SUMIBORON insert	CNGA*****NU-WG2	M10	SUMIBORON insert
CCGT*****NLV NU2	M6	SUMIBORON insert	CNGA*****NU-WH2	M10	SUMIBORON insert
CCGT*****NSC	C63	Indexable insert	CNGG*****NEF	C26	Indexable insert
CCGW**T***	M7	SUMIBORON insert	CNGG*****NFV NC4	M9	SUMIBORON insert
CCGW*****HS-NC2	M4	SUMIBORON insert	CNGG*****NLV NC4	M9	SUMIBORON insert
CCGW*****HS-NU2	M6	SUMIBORON insert	CNGG*****NSV NC4	M9	SUMIBORON insert
CCGW*****LE-NC2	M4	SUMIBORON insert	CNGG*****NGH	C26	Indexable insert
CCGW*****LF-NU2	M6	SUMIBORON insert	CNGG*****NSU	C26	Indexable insert
CCGW*****LS-NC2	M4	SUMIBORON insert	CNGM*****NLV NU2	M10	SUMIBORON insert
CCGW*****LT-NC2	M4	SUMIBORON insert	CNGX*****	M11	SUMIBORON insert
CCGW*****NC-2	M4	SUMIBORON insert	CNGX*****	M11	SUMIBORON insert
CCGW*****NC-W2	M4	SUMIBORON insert	CNMA*****	C26	Indexable insert
CCGW*****NC-WG2	M4	SUMIBORON insert	CNMA*****	M11	SUMIBORON insert
CCGW*****NC-WH2	M4	SUMIBORON insert	CNMA*****NS	M11	SUMIBORON insert
CCGW*****NS	M7	SUMIBORON insert	CNMA*****NU	M11	SUMIBORON insert
CCGW*****NU	M7	SUMIBORON insert	CNMA*****NU-W	M11	SUMIBORON insert
CCGW*****NU-2	M6	SUMIBORON insert	CNMG*****NEF	C18	Indexable insert
CCGW*****NU-WG2	M6	SUMIBORON insert	CNMG*****NEG	C20	Indexable insert
CCGW*****NU-WH2	M6	SUMIBORON insert	CNMG*****NEM	C21	Indexable insert
CCH***	G53, H9, H10	Spare parts	CNMG*****NEX	C20	Indexable insert
CCLN R/L ****_***	D25	Tool holder	CNMG*****NFA	C18	Indexable insert
CCM 6B L/R	F40	Spare parts	CNMG*****NFB	C18	Indexable insert
CCM 8 LONG	D25, D26	Spare parts	CNMG*****NFE	C18	Indexable insert
CCM 8 UL	D25, F40	Spare parts	CNMG*****NFL	C18	Indexable insert
CCM 8 UR	F40	Spare parts	CNMG*****NGE	C20	Indexable insert
CCMT*****	M8	SUMIDIA insert	CNMG*****NGU	C19	Indexable insert
CCMT*****L/R-DM NU	M8	SUMIDIA insert	CNMG*****NGU-W	C19	Indexable insert
CCMT*****NF	M8	SUMIDIA insert	CNMG*****NGZ	C23	Indexable insert
CCMT*****NFB	C64	Indexable insert	CNMG*****NLU	C18	Indexable insert
CCMT*****NFP	C64	Indexable insert	CNMG*****NLU-W	C18	Indexable insert
CCMT*****NGD NF	M8	SUMIDIA insert	CNMG*****NME	C21	Indexable insert
CCMT*****NLD NF	M8	SUMIDIA insert	CNMG*****NMU	C21	Indexable insert
CCMT*****NLB	C64	Indexable insert	CNMG*****NMX	C22	Indexable insert
CCMT*****NLU	C64	Indexable insert	CNMG*****NSE	C19	Indexable insert
CCMT*****NLU-W	C64	Indexable insert	CNMG*****NSE-W	C19	Indexable insert
CCMT*****NMU	C65	Indexable insert	CNMG*****NSU	C19	Indexable insert
CCMT*****NSC	C65	Indexable insert	CNMG*****NSX	C19	Indexable insert
CCMT*****NSK	C65	Indexable insert	CNMG*****NUG	C20	Indexable insert
CCMT*****NSU	C64	Indexable insert	CNMG*****NUP	C21	Indexable insert
CCMT**T***NUS	C65	Indexable insert	CNMG*****NUX	C22	Indexable insert
CCMW*****	C65	Indexable insert	CNMG*****NUZ	C23	Indexable insert
CCMW*****RH	M33	SUMIDIA insert	CNMM*****NHF	C24	Indexable insert
CCMW**T***	C65	Indexable insert	CNMM*****NHG	C24	Indexable insert
CCS**T*	P5	Spare parts	CNMM*****NHP	C24	Indexable insert
CGA R/L **** **	M43	SUMIBORON insert	CNMM*****NHU	C25	Indexable insert
CNGA*****	C26	Indexable insert	CNMM*****NHW	C25	Indexable insert
CNGA*****ES-NC4	M9	SUMIBORON insert	CNMM*****NMH	C24	Indexable insert
CNGA*****HS-NC2	M9	SUMIBORON insert	CNMM*****NMP	C24	Indexable insert
CNGA*****HS-NU2	M10	SUMIBORON insert	CNMQ*****N	G52	Indexable insert

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CNMU*****NG	G52	Indexable insert
CNMU*****NH	G52	Indexable insert
CNMX*****NF	M11	SUMIDIA insert
CNMX*****L/R	C26	Indexable insert
CNP****RS	G52	Cutter
CNPF****RS	G52	Cutter
CNS****	P5	Spare parts
CNS****B	P5	Spare parts
CPB**	P7	Spare parts
CPB**S	P7	Spare parts
CPB**T	P7	Spare parts
CPGT*****NSD	C66	Indexable insert
CPGW*****NC2	M5	SUMIBORON insert
CPM**N	P6	Spare parts
CPM**S	P6	Spare parts
CPMH*****NUS	C67	Indexable insert
CPMT*****NFB	C66	Indexable insert
CPMT*****NLB	C66	Indexable insert
CPMT*****NLU	C66	Indexable insert
CPMT*****NLU-W	C66	Indexable insert
CPMT*****NMU	C67	Indexable insert
CPMT*****NSU	C67	Indexable insert
CPMT*****NUS	C67	Indexable insert
CPMW*****NF	M5	SUMIDIA insert
CPU***C	P7	Spare parts
CPV**N	P6	Spare parts
CR**	P6	Spare parts
CRDN N****_***	D26	Tool holder
CRSN R/L ****_***	D26	Tool holder
CSBN R/L ****_***	D25	Tool holder
CSKN R/L ****_***	D25	Tool holder
CTL*****N/L/R	F44	Indexable insert
CTR*****N/L/R NB	F44	Indexable insert
CTR*****N/L/R	F44	Indexable insert

D

D***-DCLC R/L ****_**	E8	Boring bar
D***-DDUN R/L ****_**	E9	Boring bar
D***-DTFN R/L ****_**	E12	Boring bar
D***-DWLN R/L ****_**	E13	Boring bar
D***-SCLC R/L ****_**	E14	Boring bar
D***-SDQC R/L ****_**	E17	Boring bar
D***-SDUC R/L ****_**	E16	Boring bar
D***-STUP R/L ****_**	E20	Boring bar
D***-SVUB R/L ****_**	E21	Boring bar
D***-SVZB R/L ****_**	E21	Boring bar
DABB***C-R	M45	SUMIDIA-Bohrstange
DABB***N-R	M45	SUMIDIA-Bohrstange
DAL****H	M60	SUMIDIA-Bohrer
DC R/L-*	D25	Spare parts
DCGT*****LFX/RFX	C68	Indexable insert
DCGT*****LFX/RFX	C68	Indexable insert
DCGT*****LFY/RFY	C69	Indexable insert
DCGT*****LFY/RFY	C69	Indexable insert
DCGT*****LFYS/RFYS	C68	Indexable insert
DCGT*****LFYS/RFYS	C68	Indexable insert
DCGT*****LSD/RSD	C69	Indexable insert
DCGT*****M NFC	C68	Indexable insert

DCGT*****M NSC	C70	Indexable insert
DCGT*****M NSI	C70	Indexable insert
DCGT*****NAG	C69	Indexable insert
DCGT*****N-FV NC2	M12	SUMIBORON insert
DCGT*****N-FV NU2	M13	SUMIBORON insert
DCGT*****N-LV NC2	M12	SUMIBORON insert
DCGT*****N-LV NU2	M13	SUMIBORON insert
DCGT*****NSC	C70	Indexable insert
DCGW*****	C70	Indexable insert
DCGW*****HS-NC2	M12	SUMIBORON insert
DCGW*****HS-NU2	M13	SUMIBORON insert
DCGW*****LE-NC2	M12	SUMIBORON insert
DCGW*****LF-NU2	M13	SUMIBORON insert
DCGW*****LS-NC2	M12	SUMIBORON insert
DCGW*****LT-NC2	M12	SUMIBORON insert
DCGW*****NC-2	M12	SUMIBORON insert
DCGW*****NC-WG2	M12	SUMIBORON insert
DCGW*****NC-WH2	M12	SUMIBORON insert
DCGW*****NS	M13	SUMIBORON insert
DCGW*****NU	M13	SUMIBORON insert
DCGW*****NU-2	M13	SUMIBORON insert
DCGW*****NU-WG2	M13	SUMIBORON insert
DCGW*****NU-WH2	M13	SUMIBORON insert
DCLN R/L ****_***	D12	Tool holder
DCMT*****	M14	SUMIDIA insert
DCMT*****L/R-DM NU	M14	SUMIDIA insert
DCMT*****NF	M14	SUMIDIA insert
DCMT*****NFB	C71	Indexable insert
DCMT*****NFP	C71	Indexable insert
DCMT*****NGD NF	M14	SUMIDIA insert
DCMT*****NLD NF	M14	SUMIDIA insert
DCMT*****NLB	C71	Indexable insert
DCMT*****NLU	C71	Indexable insert
DCMT*****NMU	C71	Indexable insert
DCMT*****NSK	C71	Indexable insert
DCMT*****NSU	C71	Indexable insert
DCMW*****	C71	Indexable insert
DCMW*****RH	M33	SUMIDIA insert
DCMX**T***NLUW	C71	Indexable insert
DCS**T*	P5	Spare parts
DDHN R/L ****_***	D13	Tool holder
DDUN R/L ****_***	D13	Tool holder
DDL***V	M60	SUMIDIA drill
DDNN N ****_***	D13	Tool holder
DFC*****E	H14, H15	Indexable endmill
DFC*****E**	H15	Indexable endmill
DFCM*****E	H14, H15	Indexable endmill
DFCM*****E**	H15	Indexable endmill
DFC*****RS	G26, H14	Cutter
DFCF*****RS	G26, H14	Cutter
DFCM*****RS	G26, H14	Cutter
DGC*****EW	H6	Indexable endmill
DGC*****RS	G8	Cutter
DGCF*****RS	G8	Cutter
DGCM*****RS	G8	Cutter
DGCS**R	P5	Spare parts
DML***V	M61	SUMIDIA drill
DNGA*****	C34	Indexable insert
DNGA*****ES-NC2	M15	SUMIBORON insert
DNGA*****HS-NC2	M15	SUMIBORON insert

DNGA*****HS-NC4	M15	SUMIBORON insert
DNGA*****LE-NC2	M15	SUMIBORON insert
DNGA*****LS-NC2	M15	SUMIBORON insert
DNGA*****LT-NC2	M15	SUMIBORON insert
DNGA*****NC-2	M15	SUMIBORON insert
DNGA*****NC-4	M15	SUMIBORON insert
DNGA*****NC-WG4	M15	SUMIBORON insert
DNGA*****NC-WH4	M15	SUMIBORON insert
DNGA*****NU-2	M17	SUMIBORON insert
DNGA*****NU-WG2	M17	SUMIBORON insert
DNGA*****NU-WH2	M17	SUMIBORON insert
DNGG*****LUM/RUM	C34	Indexable insert
DNGG*****NEF	C34	Indexable insert
DNGG*****NFV NC4	M16	SUMIBORON insert
DNGG*****NLV NC4	M16	SUMIBORON insert
DNGG*****NGH	C34	Indexable insert
DNGG*****NSU	C34	Indexable insert
DNGG*****N-SV NC4	M16	SUMIBORON insert
DNGM*****N-LV NU2	M17	SUMIBORON insert
DNMA*****	C33	Indexable insert
DNMA*****	M18	SUMIBORON insert
DNMA*****NS	M18	SUMIBORON insert
DNMA*****NU	M18	SUMIBORON insert
DNMA*****RH	M18, M33	SUMIDIA insert
DNMG*****LHM/RHM	C31	Indexable insert
DNMG*****LUM/RUM	C30	Indexable insert
DNMG*****NEF	C28	Indexable insert
DNMG*****NEG	C29	Indexable insert
DNMG*****NEM	C30	Indexable insert
DNMG*****NEX	C29	Indexable insert
DNMG*****NFA	C27	Indexable insert
DNMG*****NFB	C27	Indexable insert
DNMG*****NFE	C27	Indexable insert
DNMG*****NFL	C27	Indexable insert
DNMG*****NGE	C29	Indexable insert
DNMG*****NGU	C28	Indexable insert
DNMG*****NGZ	C31	Indexable insert
DNMG*****NLU	C27	Indexable insert
DNMG*****NME	C30	Indexable insert
DNMG*****NMU	C30	Indexable insert
DNMG*****NMX	C31	Indexable insert
DNMG*****NSE	C28	Indexable insert
DNMG*****NSU	C28	Indexable insert
DNMG*****NSX	C28	Indexable insert
DNMG*****NUG	C29	Indexable insert
DNMG*****NUP	C30	Indexable insert
DNMG*****NUX	C31	Indexable insert
DNMG*****NUZ	C31	Indexable insert
DNMM*****NHG	C32	Indexable insert
DNMM*****NHP	C32	Indexable insert
DNMM*****NMP	C32	Indexable insert
DNMX*****L/R	C33	Indexable insert
DNMX*****NSE-W	C33	Indexable insert
DNS****	P5	Spare parts
DNS****B	P5	Spare parts
DNX**** RS	G16	Cutter
DNXF**** RS	G16	Cutter
DNXK**R	G16	Spare parts
DSBN R/L ****_***	D14	Tool holder
DSDN N ****_***	D14	Tool holder

DSLX*	D27	Spare parts
DSP*	D25	Spare parts
DTFN R/L ****_***	D15	Tool holder
DTGN R/L ****_***	D15	Tool holder
DTJN R/L ****_***	D15	Tool holder
DTR**C R/L ****_***	D11	Tool holder
DTR**Q R/L ****_***	D11	Tool holder
DVJN R/L ****_***	D16	Tool holder
DVQN R/L ****_***	D16	Tool holder
DWVN N ****_***	D16	Tool holder
DWLN R/L ****_***	D17	Tool holder

E

ECXA***X**LE NU*	M39	SUMIBORON insert
ECXA***X**LF NU*	M39	SUMIBORON insert
E**D*SEXCR/L**_**P	M39	Boring bar
EHBX****	P3	Spare parts
EHHM****ZX	J29	Solid endmill
ELSM****	J39	Solid endmill
ER**	P6	Spare parts

F

FBUP*-A*-*	P3	Spare parts
FMJ	P4	Spare parts
FMU****R-S	G69, M55	Cutter
FMUE	G69, M55	Spare parts
FMUJ	P4	Spare parts
FMUU	G69, M55	Spare parts

G

GCG N**** GA	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** GF	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** GF	F17, F21, F25, F37	Indexable insert
GCM N**** GG	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** GL	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** MG	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** ML	F17, F19, F21, F23, F25, F27, Indexable insert	F29, F33, F34, F37, F39
GCM N**** RG	F17, F19, F21, F23, F25, F27, Indexable insert	F37
GCM N**** RN	F17, F19, F21, F23, F25, F27, Indexable insert	F31, F33, F34, F37, F39
GCM R/L**** CF**	F17, F19, F21, F23, F25, F27, Indexable insert	F37
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GNDCF R/L ***_***	F38	Cassette
GNDCM R/L ***	F36	Cassette
GNDM R/L ****_JX***	F16	Tool holder

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GNDM R/L ****JX****	F16	Tool holder
GNDM R/L ****JX*****	F16	Tool holder
GNDM R/L ****K****	F20	Tool holder
GNDM R/L ****K****	F20	Tool holder
GNDM R/L ****K****	F20	Tool holder
GNDM R/L ****M****	F20	Tool holder
GNDM R/L ****M****	F20	Tool holder
GNDM R/L ****M****	F20	Tool holder
GNDM R/L ****P****	F20	Tool holder
GNDM R/L ****X***JE	F22, F26	Tool holder
GNDMS R/L****K****	F20	Tool holder
GNDMS R/L****M****	F20	Tool holder
GNDL R/L ****JX****	F16	Tool holder
GNDL R/L ****JX****	F16	Tool holder
GNDL R/L ****JX****	F16	Tool holder
GNDL R/L ****K****	F24	Tool holder
GNDL R/L ****K****	F24	Tool holder
GNDL R/L ****K****	F24	Tool holder
GNDL R/L ****M****	F24	Tool holder
GNDL R/L ****M****	F24	Tool holder
GNDL R/L ****M****	F24	Tool holder
GNDL R/L ****P****	F24	Tool holder
GNDLS R/L ****K****	F24	Tool holder
GNDLS R/L ****M****	F24	Tool holder
GNDF R/L ****K****_****	F32	Tool holder
GNDF R/L ****M****_****	F32	Tool holder
GNDFS R/L ****M****_****	F34	Tool holder
GNDFS R/L ****P****_****	F34	Tool holder
GNDI R/L ****T****	F28	Tool holder
GNDIS R/L ****T****	F30	Tool holder
GNDN R/L ****K****_****	F31	Tool holder
GNDN R/L ****M****_****	F31	Tool holder
GND S R/L ****K****	F18	Tool holder
GND S R/L ****M****	F18	Tool holder
GSP*	M44	Spare parts
GSP**	D27, M42	Spare parts
GSH****SF	J26	Solid endmill
GSRE****SF	J25	Solid endmill
GSX****C-****D	J7, J12, J15	Solid endmill
GSX****C-*D	J9, J10, J11, J13, J17, J18, J19	Solid endmill
GSX****S-*D	J8, J16	Solid endmill
GSXB****	J32	Solid endmill
GSXSLT****C-****D	J14	Solid endmill
GSXVL ****_****D	J20	Solid endmill
GSXVL ****S-R**_****D	J21	Solid endmill
GSXVL ****-R**_****D	J21	Solid endmill
GSXVL ****S****D	J20	Solid endmill
GWB R/L ****_****	M42	Tool holder
GWC R/L ****_****	F40	Tool holder
GWCCM R/L **	F41	Cassette
GWCI R/L ****	F41	Tool holder
GWCS R/L ****_****	F40	Tool holder
GXM N**** S ML	F30	Indexable insert
GXM N**** S GF	F30	Indexable insert
GXM N**** S GF	F30	Indexable insert

H

HBB***	M40, M45	Tool holder
HBB****	M45	Tool holder
HBSM****	M38, M39	Boring bar
HD***	P8	Spare parts
HE*****E	P5	Spare parts
HE*****P	P7	Spare parts
HE*****W	E13	Spare parts
HFJ	G62, G63, H61, M48	Spare parts
HFVT	G62, G63, H61, M48	Spare parts
HPS****N*	P7	Spare parts

J

J-G1/8-G1/8-**E	F22, F26	Parts
J-G1/8-G1/8F-**E	F22, F26	Parts
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KDS***FA	K50	Multi-drill
KDS***LAK	K46, K47	Multi-drill
KDS***MAK	K44, K45	Multi-drill
KGBS****	P4	Spare parts
KSS****	P4	Spare parts

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LCL*	P4	Spare parts
LCL**	P4	Spare parts
LCL*C-SD	P4	Spare parts
LCL*D-SD	P4	Spare parts
LCL*DB-SD	P4	Spare parts
LCL*S	P4	Spare parts
LCL*-SD	P4	Spare parts
LCL*T-SD	P4	Spare parts
LCS*	P4	Spare parts
LCS**	P4	Spare parts
LCS**BS-SD	P4	Spare parts
LCS*B-SD	P4	Spare parts
LCS*CA	P4	Spare parts
LCS*DB-SD	P4	Spare parts
LCS*TB-SD	P4	Spare parts
LCS*TE	P4	Spare parts
LH***	P8	Spare parts
LH***K	P8	Spare parts
LHHM****ZX	J29	Solid endmill
LNEX*****PNER-G	G33, G34, G35, H18, H19	Indexable insert
LNEX*****PNER-H	G33, G35, H18, H19	Indexable insert
LNEX*****PNER-L	G33, G34, G35, H18, H19	Indexable insert
LNMX*****PNSN-G	G51	Indexable insert
LNMX*****PNSN-H	G51	Indexable insert
LNMX*****PNSR-L	G37	Indexable insert
LNMX*****PNSR-G	G37	Indexable insert
LNMX*****PNSR-R	G37	Indexable insert
LP**	P7	Spare parts

LSC**SD	P5	Spare parts
LSD**SD	P5	Spare parts
LSM****	J38	Solid endmill
LSP*D	D34	Spare parts
LSP*	P7	Spare parts
LSP**	P7	Spare parts
LSP*SD	P7	Spare parts
LSR**	P5	Spare parts
LSR***	P5	Spare parts
LSS**SD	P5	Spare parts
LST**SD	P5	Spare parts
LST***SD	P5	Spare parts
LSTE**_*	P5	Spare parts
LSW***	P6	Spare parts
LT**	P8	Spare parts
LT**_*	P8	Spare parts
LT**IP	P8	Spare parts
LT**K	P8	Spare parts
LTER****	F54	Tool holder

M

MA**M**L***C	H5	Tool holder
MA**M**L***S	H5	Tool holder
MDF****S2D	K26	Multi-drill
MDF****L2D	K27	Multi-drill
MDF****H3D	K29, K30	Multi-drill
MDF****H5D	K29, K30	Multi-drill
MDS***MKHAK	K23	Multi-drill
MDS****SDC*	K41	Multi-drill
MDS***SKHAK	K22	Multi-drill
MDSS****	K40	Multi-drill
MDUS****_*C	K40	Multi-drill
MDW****GS*	K20, K21	Multi-drill
MDW****NHGS	K36, K37	Multi-drill
MDW****PHT	K34, K35	Multi-drill
MDW***XHG-S**HAK	K34	Multi-drill
MDW***XHT-A**HAK	K35	Multi-drill
MIB*_*	P4	Spare parts
MLDH****L**	K39	Multi-drill
MLDH****P	K39	Multi-drill
MMW**	D23	Spare parts
MP***	P7	Spare parts
MSX*****EM	H9	Indexable endmill
MSX*****ES	H9	Indexable endmill
MSX*****EW	H9	Indexable endmill
MSX*****M**Z*	H10	Indexable endmill
MSX*****RS	G53	Cutter
MTJN R/L ****_*	D23	Tool holder
MTJN R/L V-**	D23	Tool holder
MTXN R/L ****_*	D23	Tool holder
MWLN R/L ****_*	D24	Tool holder
MWW**	D24	Spare parts

N

NPDB****_*	J43, M59	SUMIDIA endmill
NPDBS****_*	J43, M59	SUMIDIA endmill
NPDRS****R****_*	J42, M58	SUMIDIA endmill

O

ONEU****ANER L	G9, H6	Indexable insert
ONEU****ANER G	G9, H6	Indexable insert
ONMU****ANER L	G9, H6	Indexable insert
ONMU****ANER G	G9, H6	Indexable insert

P

P*	G69, M55	Spare parts
PCBN R/L ****_*	D18	Tool holder
PCLC R/L ****_*	D31	Tool holder
PCLN R/L ****_*	D18	Tool holder
PCT***D*S**	K71	Multi-drill
PDJC R/L ****_*	D32	Tool holder
PDJN R/L ****_*	D19	Tool holder
PDL***D*S**	K71	Multi-drill
PRDC N****_*	D34	Tool holder
PRGC R/L ****_*	D34	Tool holder
PSBN R/L ****_*	D20	Tool holder
PSC**DCLN R/L *****-12	D41	Polygon tool holder
PSC**DDJN R/L *****-15	D41	Polygon tool holder
PSC**DDHN R/L *****-15	D41	Polygon tool holder
PSC**DSBN R/L *****-12	D41	Polygon tool holder
PSC**DTJN R/L *****-16	D42	Polygon tool holder
PSC**DWLN R/L *****-0*	D42	Polygon tool holder
PSC**GM** R/L *****	F36, F38, M43	Polygon modular tool holder
PSC**SCLC R/L *****-09	D43	Polygon tool holder
PSC**SDJC R/L *****-11	D43	Polygon tool holder
PSC**SDHC R/L *****-11	D43	Polygon tool holder
PSC**SSBC R/L *****-12	D43	Polygon tool holder
PSC**STJC R/L *****-16	D44	Polygon tool holder
PSC**SVJB R/L *****-16	D44	Polygon tool holder
PSC**SVVB R/L *****-16	D44	Polygon tool holder
PSC**SVHB R/L *****-16	D44	Polygon tool holder
PSC**SVJC R/L *****-16	D45	Polygon tool holder
PSC**SVVC R/L *****-16	D45	Polygon tool holder
PSC**SVHC R/L *****-16	D45	Polygon tool holder
PSDN N ****_*	D20	Tool holder
PSKN R/L ****_*	D21	Tool holder
PSSN R/L ****_*	D21	Tool holder
PTFN R/L ****_*	D22	Tool holder
PTGN R/L ****_*	D22	Tool holder
PTTN R/L ****_*	D22	Tool holder
PWC**** R/L-S	G50	Cutter
PWCF**** R/L-S	G50	Cutter
PWLN R/L ****_*	D24	Tool holder
PWS**** RS	G37	Cutter
PWSF**** RS	G37	Cutter
PWSS*R	P6	Spare parts

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Q

QPET*****PPFR-S	G18, H52, H53	Indexable insert
QPMT*****PPEN	G18, H52, H53	Indexable insert
QPMT*****PPEN-CP	G18	Indexable insert
QPMT*****PPEN-H	G18, H52, H53	Indexable insert

R

RCMT****M0 NRH	C72	Indexable insert
RCMT****M0 NRX	C72	Indexable insert
RCMX****M0 NRP	C72	Indexable insert
RDET**T*M0EN-G	G23, H54, H55	Indexable insert
RDET**T*M0EN-H	G23, H54, H55	Indexable insert
RDET***M0EN-G	G23, H54, H55	Indexable insert
RDET***M0EN-H	G23, H54, H55	Indexable insert
RF-SET	G66, M52, M55	Spare parts
RF****RS	G66, M52	Cutter
RFB	G66, M52	SUMIDIA insert
RFBW	G66, M52	SUMIDIA insert
RFC	G66, M52	Spare parts
RFD	G66, M52	Spare parts
RFF	G66, M52	Spare parts
RFJ	P4	Spare parts
RFR	G66, M52	Spare parts
RFS	G66, M52	Spare parts
RNGN*****	G66, M52	SUMIBORON insert
RNGN*****B	G66, M52	SUMIBORON insert
RSX****ES	G20, H54	Indexable endmill
RSXF****ES	G20, H54	Indexable endmill
RSX****M	G20, H54	Indexable endmill
RSXF****M	G20, H54	Indexable endmill
RSX****RS	G20, G22	Cutter
RSXF****RS	G20, G22	Cutter

S

S***-DTR**C-R/L-**	E11	Boring bar
S***-MWLN R/L **	E13	Boring bar
S***-PCLN R/L **	E8	Boring bar
S***-PDUN R/L **	E9	Boring bar
S***-PSKN R/L **	E10	Boring bar
S***-PTFN R/L **	E12	Boring bar
S***-SCLC R/L **	E14	Boring bar
S***-SCLP R/L **	E15	Boring bar
S***-SDQC R/L **	E17	Boring bar
S***-SDUC R/L **	E16	Boring bar
S***-SSKP R/L **	E18	Boring bar
S***-STFC R/L **	E19	Boring bar
S***-STUB R/L **_**	E20	Boring bar
S***-STUP R/L **	E20	Boring bar
S***-STUP R/L **_**	E20	Boring bar
S***-SVQB R/L **	E22	Boring bar
S***-SVUB R/L **	E22	Boring bar
S***-SVZB R/L **	E23	Boring bar
S***-SWUB R/L **	D11, E11	Boring bar
S-SP*-**	G33, G35, H18, H19	Spare parts
S-UF*S R/L	G14	Spare parts
SBN**_**	F46, F48	Tool holder

SBU**_**	F46, F48	Tool holder
SCAC R/L ****_**	D31	Tool holder
SCGT**T***LFX/RFX	C73	Indexable insert
SCGT*****M NSC	C73	Indexable insert
SCGW*****NU	M19	SUMIBORON insert
SCLC R/L ****_**	D31	Tool holder
SCMT*****NFB	C74	Indexable insert
SCMT*****NFP	C74	Indexable insert
SCMT*****NLB	C74	Indexable insert
SCMT*****NLU	C74	Indexable insert
SCMT*****NMU	C74	Indexable insert
SCMT*****NSK	C74	Indexable insert
SCMT*****NSU	C74	Indexable insert
SCMW*****	C74	Indexable insert
SCN****	P5	Spare parts
SCND****	P5	Spare parts
SCP-*	D12, D13, D14, D15, D16, D17, D41, D42, E8, E9, E12, E13	Spare parts
SCP*A	F41	Spare parts
SCS****	P5	Spare parts
SCT R/L ****	F44	Tool holder
SCW**	P5	Spare parts
SDAC R/L ****_**	D33	Tool holder
SDBSM	M39	Spare parts
SDET****ZDFR	G66, M52	Indexable insert
SDHC R/L ****_**	D32	Tool holder
SDJC R/L ****_**	D32	Tool holder
SDM****U*HAK	K15, K16, K17	Multi-drill
SDNC N ****_**	D33	Tool holder
SDP****U*HAK	K8, K9, K10	Multi-drill
SDW**	P5	Spare parts
SECW****AGTN-N-NF	G13	Indexable insert
SEET****AGFN-L	G13	Indexable insert
SEET****AGFR-L	G11, H7	Indexable insert
SEET****AGSN-G	G13	Indexable insert
SEET****AGSN-N	G13	Indexable insert
SEET****AGSR-L	G11, H7	Indexable insert
SEET****AGSR-G	G11, H7	Indexable insert
SEMT****AGSN-G	G13	Indexable insert
SEMT****AGSN-H	G13	Indexable insert
SEMT****AGSN-L	G13	Indexable insert
SEMT****AGSR-L	G11, H7	Indexable insert
SEMT****AGSR-G	G11, H7	Indexable insert
SEMT****AGSR-H	G11, H7	Indexable insert
SEMT****AGSR-FG	G11, H7	Indexable insert
SFKN****AZFN	G15	Indexable insert
SFKN****AZTN	G15	Indexable insert
SFKR****AZTN	G15	Indexable insert
SFW**	P5	Spare parts
SL-*	F46, F48, F49	Spare parts
SMD	K55, K62	Multi-drill
SMDH***S/M/L/D*	K52, K56, K59	Multi-drill
SMDT****MFS	K57	Indexable insert
SMDT****MTL	K59	Indexable insert
SMDT****D MEL	K54	Indexable insert
SMDT****D MTL	K53	Indexable insert
SNB****DL	J33	Solid endmill
SNEU****ANER-FG	G9, H6	Indexable insert
SNEU****ANER-FL	G9, H6	Indexable insert
SNEU****ANER-G	G9, H6	Indexable insert

SNEU****ANER-L	G9, H6	Indexable insert
SNEW****ADFR-NF	G66, M52	SUMIDIA insert
SNEW****ADFR-W-NF	G66, M52	SUMIDIA insert
SNEW****ADTR-NF	G67, M53	SUMIDIA insert
SNEW****ADTR-R-NF	G67, M53	SUMIDIA insert
SNEW****ADTR-U-NF	G67, M53	SUMIDIA insert
SNEW****ADT L/R	G69, M55	SUMIBORON insert
SNEW****ADT L/R-S	G69, M55	SUMIBORON insert
SNGA*****	C42	Indexable insert
SNGA*****HS-NC2	M19	SUMIBORON insert
SNGA*****HS-NC4	M19	SUMIBORON insert
SNGA*****NC-4	M19	SUMIBORON insert
SNGG*****LST/RST	C42	Indexable insert
SNGG*****LUM/RUM	C42	Indexable insert
SNGN*****	C43	Indexable insert
SNGN*****	M19	SUMIBORON insert
SNGX*****	M19	SUMIBORON insert
SNMA*****	C42	Indexable insert
SNMA*****NS	M20	SUMIBORON insert
SNMA*****NU	M20	SUMIBORON insert
SNMA*****RH	M20, M33	SUMIDIA insert
SNMG*****LUM/RUM	C37	Indexable insert
SNMG*****LHM/RHM	C39	Indexable insert
SNMG*****NEF	C36	Indexable insert
SNMG*****NEG	C37	Indexable insert
SNMG*****NEM	C38	Indexable insert
SNMG*****NEX	C37	Indexable insert
SNMG*****NFB	C35	Indexable insert
SNMG*****NFE	C35	Indexable insert
SNMG*****NFL	C35	Indexable insert
SNMG*****NGE	C36	Indexable insert
SNMG*****NGU	C36	Indexable insert
SNMG*****NGZ	C39	Indexable insert
SNMG*****NLU	C35	Indexable insert
SNMG*****NME	C38	Indexable insert
SNMG*****NMU	C38	Indexable insert
SNMG*****NMX	C39	Indexable insert
SNMG*****NSE	C35	Indexable insert
SNMG*****NSJ	C36	Indexable insert
SNMG*****NSU	C35	Indexable insert
SNMG*****NSX	C36	Indexable insert
SNMG*****NUG	C37	Indexable insert
SNMG*****NUP	C37	Indexable insert
SNMG*****NUX	C38	Indexable insert
SNMG*****NUZ	C39	Indexable insert
SNMN*****	C43	Indexable insert
SNMM*****NHF	C41	Indexable insert
SNMM*****NHG	C40	Indexable insert
SNMM*****NHGS	C40	Indexable insert
SNMM*****NHP	C40	Indexable insert
SNMM*****NHU	C41	Indexable insert
SNMM*****NHW	C41	Indexable insert
SNMM*****NMH	C40	Indexable insert
SNMM*****NMP	C40	Indexable insert
SNMT****ZNEN-G	G17	Indexable insert
SNMT****ZNEN-H	G17	Indexable insert
SNMT****ZNEN-SH	G17	Indexable insert
SNMU****ANER FG	G9, H6	Indexable insert
SNMU****ANER FL	G9, H6	Indexable insert
SNMU****ANER G	G9, H6	Indexable insert

SNMU****ANER H	G9, H6	Indexable insert
SNMU****ANER L	G9, H6	Indexable insert
SNS****	P5	Spare parts
SOET*****PDFR-S	G28, G31, G57, H13, H17, H57, H58	Indexable insert
SOET*****PZER-G	G28, G30, G56, H13, H16, H57, H58	Indexable insert
SOET*****PZFR-S	G28, G30, G56, H13, H16, H57, H58	Indexable insert
SOMT*****PDER-L	G28, G31, G57, H13, H17, H57, H58	Indexable insert
SOMT*****PDER-G	G28, G31, G57, H13, H17, H57, H58	Indexable insert
SOMT*****PDER-H	G28, G31, G57, H13, H17, H57, H58	Indexable insert
SOMT*****PZER-L	G28, G30, G56, H13, H16, H57, H58	Indexable insert
SOMT*****PZER-G	G28, G30, G56, H13, H16, H57, H58	Indexable insert
SOMT*****PZER-H	G28, G30, G56, H13, H16, H57, H58	Indexable insert
SPGN*****	C77	Indexable insert
SPGT*****LSD/RSD	C76	Indexable insert
SPGW*****	C76	Indexable insert
SPGW*****T	C76	Indexable insert
SPMA*****	H47	Indexable insert
SPMA*****T	H47	Indexable insert
SPMN*****	C35	Indexable insert
SPMR*****NFK	C35	Indexable insert
SPMR*****NSF	C36	Indexable insert
SPMR*****NUJ	C36	Indexable insert
SPMT*****	C39	Indexable insert
SPMT*****NFB	C35	Indexable insert
SPMT*****NFK	C38	Indexable insert
SPMT*****NLB	C38	Indexable insert
SPMT*****NLU	C39	Indexable insert
SPMT*****NSF	C35	Indexable insert
SPMT*****NUS	C75	Indexable insert
SPP*	P7	Spare parts
SPP**	P7	Spare parts
SRDC N ****_***	D35	Tool holder
SRF**R-ST	G67, M53	Cutter
SRF**RS	G67, M53	Cutter
SRFJ	P4	Spare parts
SRND**	P5	Spare parts
SRNS***SD	D35	Spare parts
SRSC R/L ****_***	D35	Tool holder
SSBC R/L ****_***	D36	Tool holder
SSEH****R**	J35	Solid endmill
SSEH****W-R**	J24	Solid endmill
SSEH****WS-R**	J24	Solid endmill
SSEHVL ****-R**	J35	Solid endmill
SSEHVL ****W-R**	J23	Solid endmill
SSEHVL ****WS-R**	J23	Solid endmill
SSM****	J36, J37	Solid endmill
SSN****	P5	Spare parts
SSND***	P5	Spare parts
SSUP*****ZX	J31	Solid endmill
SSUP*****ZX-R**	J31	Solid endmill
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STAC R/L ****_***	D37	Tool holder
STER****	F54	Tool holder
STFH*_*	F46	Tool holder
STFS R/L ****_*	F46	Tool holder
STGC R/L ****_***	D37	Tool holder
STIR***	F55	Tool holder
STPD***	P6	Spare parts
STW***	P6	Spare parts
SUF*S R/L	G14	Spare parts
SVJB R/L ****_***	D38	Tool holder
SVLC R/L ****_***	D39	Tool holder
SVP**	D38, E21, E22	Spare parts
SVPB R/L ****_***	D38	Tool holder
SVPC R/L ****_***	D39	Tool holder
SVVB N ****_***	D38	Tool holder
SVW***	P5	Spare parts
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T

TBGN*****	C86	Indexable insert
TBGN*****B	M20	SUMIBORON insert
TBGN*****NF	M20	SUMIDIA insert
TBGR*****LW	C86	Indexable insert
TBGT*****LFW/RFX	C78	Indexable insert
TBGT*****LFX/RFX	C78	Indexable insert
TBGT*****LFY/RFY	C78	Indexable insert
TBGT*****LW/RW	C78	Indexable insert
TBGW*****	C78	Indexable insert
TBGW*****NF	M20	SUMIDIA insert
TCGT*****LFX/RFX	C79	Indexable insert
TCGT*****LFY/RFY	C79	Indexable insert
TCGT*****M NSC	C79	Indexable insert
TCGT*****M NSI	C79	Indexable insert
TCGT*****NAG	C79	Indexable insert
TCGW*****NC	M21	SUMIBORON insert
TCGW*****NC-3	M21	SUMIBORON insert
TCGW*****NU	M21	SUMIBORON insert
TCMT*****NF	M21	SUMIDIA insert
TCMT*****NFB	C80	Indexable insert
TCMT*****NFP	C80	Indexable insert
TCMT*****NLB	C80	Indexable insert
TCMT*****NLU	C80	Indexable insert
TCMT*****NSK	C80	Indexable insert
TCMT*****NSU	C80	Indexable insert
TCMW*****	C80	Indexable insert
TCS**T*	P6	Spare parts
TEGN*****	C87	Indexable insert
TGA R/L ****BF	F41	Indexable insert
TGA R/L ****(E)	F42	Indexable insert
TGA R/L ****R	F43	Indexable insert
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TME***R	F53, F54	Indexable insert
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TNGA*****	C52	Indexable insert

TNGA*****HS-NC3	M22	SUMIBORON insert
TNGA*****HS-NC6	M22	SUMIBORON insert
TNGA*****LE-NC3	M22	SUMIBORON insert
TNGA*****LS-NC3	M22	SUMIBORON insert
TNGA*****LT-NC3	M22	SUMIBORON insert
TNGA*****LF-NU3	M23	SUMIBORON insert
TNGA*****NC6	M22	SUMIBORON insert
TNGA*****NU3	M23	SUMIBORON insert
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TNGG*****LFY/RFY	C51	Indexable insert
TNGG*****LFX/RFX	C51	Indexable insert
TNGG*****LST/RST	C51	Indexable insert
TNGG*****LUM/RUM	C52	Indexable insert
TNGG*****N-FV NC6	M22	SUMIBORON insert
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TNGG*****NGH	C52	Indexable insert
TNGG*****NSU	C51	Indexable insert
TNGG*****N-SV NC6	M22	SUMIBORON insert
TNGM*****N-LV NU3	M23	SUMIBORON insert
TNMA*****	C50	Indexable insert
TNMA*****	M24	SUMIBORON insert
TNMA*****NU	M24	SUMIBORON insert
TNMG*****LHM/RHM	C48	Indexable insert
TNMG*****LUM/RUM	C46	Indexable insert
TNMG*****NEF	C44	Indexable insert
TNMG*****NEG	C46	Indexable insert
TNMG*****NEM	C47	Indexable insert
TNMG*****NEX	C46	Indexable insert
TNMG*****NFA	C44	Indexable insert
TNMG*****NFB	C44	Indexable insert
TNMG*****NFE	C44	Indexable insert
TNMG*****NFL	C44	Indexable insert
TNMG*****NGE	C45	Indexable insert
TNMG*****NGU	C45	Indexable insert
TNMG*****NGZ	C48	Indexable insert
TNMG*****NLU	C44	Indexable insert
TNMG*****NME	C47	Indexable insert
TNMG*****NMU	C47	Indexable insert
TNMG*****NMX	C47	Indexable insert
TNMG*****NSE	C45	Indexable insert
TNMG*****NSU	C44	Indexable insert
TNMG*****NSX	C45	Indexable insert
TNMG*****NUG	C46	Indexable insert
TNMG*****NUP	C46	Indexable insert
TNMG*****NUX	C47	Indexable insert
TNMG*****NUZ	C48	Indexable insert
TNMM*****NHG	C49	Indexable insert
TNMM*****NHP	C49	Indexable insert
TNMM*****NMP	C49	Indexable insert
TNMM*****	C49	Indexable insert
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TPGN*****	C86	Indexable insert
TPGN*****NF	M24	SUMIDIA insert
TPGN*****NU	M24	SUMIBORON insert
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TPGT*****LFX/RFX	C81	Indexable insert
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TPGT****N-FV NU3	M26	SUMIBORON insert
TPGW*****	C82	Indexable insert
TPGW*****	M26	SUMIBORON insert
TPGW*****LE-NC3	M25	SUMIBORON insert
TPGW*****LS-NC3	M25	SUMIBORON insert
TPGW*****LT-NC3	M25	SUMIBORON insert
TPGW*****NC	M25	SUMIBORON insert
TPGW*****NC3	M25	SUMIBORON insert
TPGW*****NF	M26	SUMIDIA insert
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TRDR**IP	P8	Spare parts
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TRM*****-GU	C50, D11, E11	Indexable insert
TRM*****-LU	C50, D11, E11	Indexable insert
TRM*****-SU	C50, D11, E11	Indexable insert
TRW****	P6	Spare parts
TRX**	P8	Spare parts
TRX**IP	P8	Spare parts
TRX**IP**	D35	Spare parts
TRXW**IP	P7	Spare parts
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TSXF****E	G32, H18, H19	Indexable endmill
TSXM****E	G32, H18, H19	Indexable endmill
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TSXF****RS	G32, G34, H18	Cutter
TSXM****RS	G32, G35, H18	Cutter
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U

UF*K R/L	G14	Spare parts
UF*S R/L	G14	Spare parts
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VBGT*****LFY/RFY	C89	Indexable insert
VBGT*****LFYS/RFYS	C89	Indexable insert
VBGT*****M NSI	C89	Indexable insert
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VBGW*****LE-NC2	M28	SUMIBORON insert
VBGW*****LS-NC2	M28	SUMIBORON insert
VBGW*****LT-NC2	M28	SUMIBORON insert
VBGW*****NC	M28	SUMIBORON insert
VBGW*****NC2	M28	SUMIBORON insert
VBGW*****NU	M28	SUMIBORON insert
VBGW*****NU2	M28	SUMIBORON insert
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VBMT*****NLB	C88	Indexable insert
VBMT*****NLU	C88	Indexable insert
VBMT*****NMU	C88	Indexable insert
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VNGA*****LT-NC2	M30	SUMIBORON insert
VNGA*****NC2	M30	SUMIBORON insert
VNGA*****NC4	M30	SUMIBORON insert
VNGA*****NU2	M30	SUMIBORON insert
VNGG*****NEF	C55	Indexable insert
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VNGG*****NLV NC2	M30	SUMIBORON insert
VNGG*****NSU	C55	Indexable insert
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VNMA*****	M31	SUMIBORON insert

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VNMA****RH	M31, M33	SUMIDIA insert
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VNMG****NEG	C54	Indexable insert
VNMG****NEX	C54	Indexable insert
VNMG****NFA	C53	Indexable insert
VNMG****NFB	C53	Indexable insert
VNMG****NFE	C53	Indexable insert
VNMG****NFL	C53	Indexable insert
VNMG****NGE	C54	Indexable insert
VNMG****NGU	C54	Indexable insert
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WNMG*****NFA	C56	Indexable insert
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Z

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SAFETY INSTRUCTIONS

Target Products	Hazards	Measures
General precautions for cutting tools	The tools have sharp cutting edges. There is a risk of injury if held directly with bare hands.	Always wear protective equipment, such as protective tools when removing the tool from the case or mounting it onto a machine.
	Improper use or incorrect use conditions may cause the tool to break or scatter, and could cause injury.	Always use protective equipment such as safety covers and protective eyewear. Always use within the scope of the recommended conditions. Refer to the instruction manual, catalogue and other relevant documents.
	The tool could break and fly off if the cutting force increases suddenly because of impact loads or excessive wear and could cause injury.	Always use protective equipment such as safety covers and protective eyewear. Replace the tool at an early stage.
	Very hot chips could scatter or elongated chips could be discharged, and cause injury or burns.	Always use protective equipment such as safety covers and protective eyewear. When removing the chips, always stop the machine, wear protective gloves, and use tools such as nippers or clippers.
	The tool and work materials will become very hot during turning. There is a risk of burn if these are touched directly with bare hands immediately after machining.	Always wear protective equipment such as protective gloves.
	There is a risk of igniting or fires from the sparks generated during turning, or the heat generated from broken pieces and chips.	Do not use in an area where there is a risk of fires or explosions. Always provide fire prevention measures when using water-insoluble turning oil solution.
	When using at a high rotation speed, if the balance including the machine tool holder is poor, the deflection or vibration could cause tool damage and injury.	Always use protective equipment such as safety covers and protective eyewear. Always carry out trial operation, and confirm that there is no deflection, vibration or abnormal noise.
General precautions for cutting edge indexable tools	There is a risk of injury if you touch the burrs formed on the workpiece with bare hands.	Do not touch with bare hands.
	If insert or parts are not properly clamped, they could come off or fly off during turning and cause injury.	Clean the mounting surface and fixing parts free of foreign matter, before mounting the insert. When mounting, use the enclosed spanner and confirm that the insert and parts are securely clamped. Never use parts other than the designated inserts or parts.
	If the parts are tightened excessively with an auxiliary tool such as a pipe, the insert or part could break and come off or fly off.	Do not use auxiliary tools such as pipes. Use the enclosed spanner.
Various cutters and other tools used with rotation	Using the tool with high-speed rotation is extremely dangerous as the parts or inserts could fly off with the centrifugal force. Pay special attention to safety when handling.	Always use within the scope of the recommended conditions. Refer to the instruction manual, catalog and other relevant documents.
	The cutters have very sharp cutting edges. Touching these with bare hands could result in injury.	Always wear protective equipment such as protective gloves.
Drills	Tools could sway or vibrate if the eccentric rotation or balance is poor. There is a risk of injury if they break or fly off.	Keep the rotation speed within the scope of the recommended conditions. Periodically adjust the accuracy and balance of the rotating sections so that eccentric rotation or deflection do not occur because of bearing wear, etc.
	When machining a through hole while rotating the workpiece, a disc-shaped uncut section may fly off at the point of penetration. This disc is sharp and very dangerous.	Always use protective equipment such as safety covers and protective eyewear. Also take measures such as attaching a cover to the chuck section.
Brazing tool	The very small drill has a pointed end, and is very sharp. It could stab or break when directly touched with a finger, and be difficult to remove. The end could fly off if it breaks.	Take special care to safety when handling. Always wear protective gloves and protective eyewear, etc.
	There is a risk of injury if the insert comes off or breaks, etc.	Confirm that the insert is properly brazed before using. Do not use in conditions that could become very hot.
Others	Repeated brazing is dangerous as the insert could break during use.	Do not use an insert that has been repeatedly brazed as the strength will have dropped.
	Using this product for a purpose other than the designated application can break the machine or tool and is very dangerous.	Observe the designated usage.

Finally, this brochure describes the basic safety information. For further information, refer to the instruction manual, catalog and other relevant documents for each tool, or contact Sumitomo Electric Hardmetal. Sumitomo Electric Hardmetal will not be held liable for any damage and injuries resulting from changes to the specifications, including alterations and modifications, made without consent from Sumitomo Electric Hardmetal.

Tool Engineering Services

In order to provide a higher level of support and satisfaction for our customers, Sumitomo Electric Industries has created the Tool Engineering Service system.

We have created several Tool Engineering Centers around the world as bases for this support. The Tool Engineering Centers provide a wide range of support to assist user manufacturing activities, with services including training (at the Center), test cuts, technical consulting, line diagnostics (at the user's site) and tooling proposals.



Tool Engineering Center Locations

Japan

- ▶ Itami Tool Engineering Center (I-TEC)
- ▶ Yokohama Tool Engineering Center (Y-TEC)
- ▶ Hokkaido Igetalloy Tool Engineering Center (H-TEC)
- ▶ Tokai Tool Engineering Center (T-TEC)
- ▶ Kyushu Tool Engineering Center (K-TEC)

Overseas

- ▶ Germany / European Design & Engineering Center (E-DEC)
- ▶ Thailand / Thailand Tool Engineering Center (Ti-TEC)
- ▶ Shanghai / Shanghai Tool Engineering Center (S-TEC)
- ▶ U.S.A. / Americas Tool Engineering Center (A-TEC)
- ▶ Indonesia / Indonesia Tool Engineering Center (In-TEC)
- ▶ India Tool Engineering Center

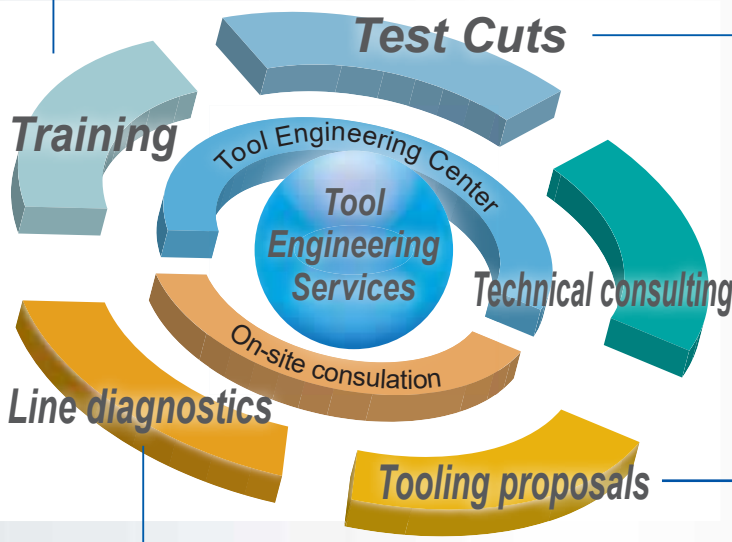
1 Training

To make it easy for anyone to take part, the Centers offer training courses designed for a variety of different training objectives and participants.

*Contact your nearest SEI sales office for detailed training curricula.

2 Performance evaluation technology

To attain improvements in machining on sites, manufacturers must rely on more than just the subjective guidance provided by experience and instinct. Today's advanced measuring instruments can make machining phenomena observable, and clarify problems.



3 Test cuts and technical consulting

The Tool Engineering Centers can make test cuts on user workpieces, and work with users to create more detailed technical proposals. The Centers can also provide solutions to various machining problems, general line diagnostics for machining lines, and tooling support for new lines.

*Contact your nearest SEI sales office for more information.



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CUTTING TOOLS

WORLDWIDE LOCATIONS

We are strengthening its global position for high-quality products and services, while contributing technology to market needs around the world.



- Sales Network
- Production Network
- Tool Engineering Center



H Sumitomo Electric Industries Ltd. Hardmetal Div. Sumitomo Electric Hardmetal Corp.

Production Network

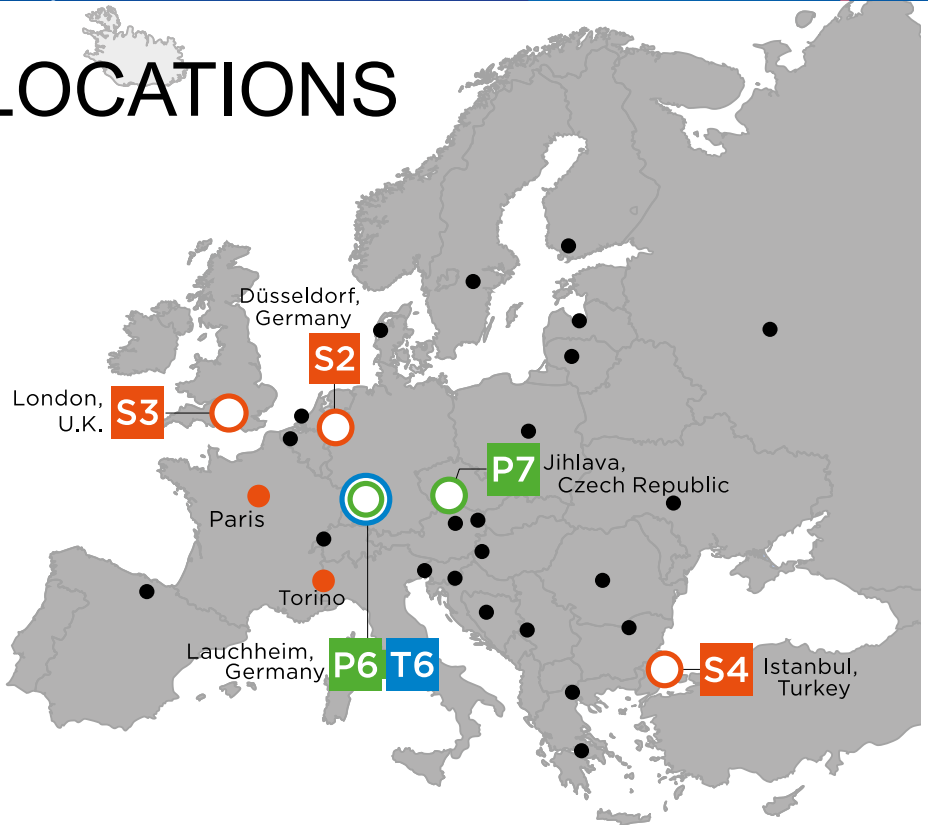
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HARDMETAL GROUP

CUTTING TOOLS EUROPEAN LOCATIONS



S2 Sumitomo Electric Hartmetall GmbH



- T1** Itami Tool Engineering Center (I-Tec)
- T2** Hokkaido Tool Engineering Center (H-Tec)
- T3** Yokohama Tool Engineering Center (Y-Tec)
- T4** Tokai Tool Engineering Center (T-Tec)
- T5** Kyushu Tool Engineering Center (K-Tec)

- T6** European Design & Engineering Center (E-DEC)
- T7** Shanghai Tool Engineering Center (S-Tec)
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- T9** Indonesia Tool Engineering Center (In-Tec)
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- Sales Network
- Production Network
- Tool Engineering Center

Sales Network



S1 Sumitomo Electric Tool Net, Inc.



S3 Sumitomo Electric Hardmetal Ltd.



S4 SumiSermetal Ticaret ve Sanayi Limited Şirketi



S5 Sumitomo Electric Hardmetal Trading (Shanghai) Co., Ltd.



S6 Superior Engineering Tool Trading (Shanghai) Co., Ltd.



S7 Sumitomo Electric Hardmetal Asia Pacific Pte Ltd.



S8 Sumitomo Electric Hardmetal (Thailand) Ltd.



S9 PT. Sumitomo Electric Hardmetal Indonesia



S10 SEI Carbide Australia Pty Ltd.



S11 Motherson Techno Tools Ltd.



S12 Sumitomo Electric Carbide, Inc.



S13 Sumicarbide Canada Inc.



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